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ABSTRACT

This volume summarizes the National Science Foundation's evaluation of 19 precollege curriculum projects in mathematics, science, and social science. The projects were examined by 73 consultants, including experts in science, mathematics, and child and adolescent development, and educators, education administrators, representatives of the publishing industry, and members of the public. The consultants were divided into seven panels and charged with answering ten evaluative questions dealing with the accuracy, appropriateness, implementation, cost, and educational soundness of the projects. These independent evaluations were used by the NSF in making decisions about the future of the 19 projects. (Author/DS)

Panel Evaluation of 19 Pre-College Curriculum Development Projects

DECEMBER 8-12, 1975

NATIONAL SCIENCE FOUNDATION
Directorate for Science Education

NSF 76-23

FOREWORD

During the week of December 8-12, 1975, 73 people met in Washington, D.C. in seven panels to assist in a review and evaluation of the 19 pre-college curriculum development projects currently being supported by the National Science Foundation. This review was responsive to guidance from the Congress and from the National Science Board (NSB), the Foundation's chief policy-making body.

Fifty-five organizations were asked to nominate panelists and two other organizations volunteered nominees after learning of the review. The organizations represented the scientific, educational and child development communities, as well as publishers, and the public. Of these, 42 organizations provided lists of nominees from which the 73 panelists were selected.

This report documents the reason for the review, its organization, and the reviewers' responsibilities. It also contains the full report of each panel, individual panelists' comments, the perspectives of the directors of the 19 projects, and descriptive material about each project.

After completion of the draft report, each project director was asked to verify its factual content, and each panelist was asked to formally certify the correctness of his or her contribution. All panelists have done this with the exception of one panelist who was out of the country and could not be reached. Every effort was made to include all corrections provided in this final report and to insure accuracy. The National Science Foundation takes responsibility for any errors that may persist. The panel reports reflect the views of the panelists alone, and not those of the NSF staff. The NSF goal was to produce a broad, independent evaluation of an important program.

In late February 1976, NSF made major decisions about the future of the 19 projects. The panel reports were used as important sources of information and guidance, but were not the only source of information for decision making. All information NSF had about each project was considered and weighed. In addition, budgetary, programmatic, and policy issues were weighed. Responsibility for all decisions rests solely with NSF.

I want to express my appreciation to the panelists, the project directors, and members of the staff for their assistance and cooperation, and for the grace, good humor, and excellence with which they approached and completed a difficult task.

Harvey Averch
Acting Assistant Director
for Science Education

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A. INTRODUCTION

This report details the efforts of the National Science Foundation to evaluate nineteen pre-college curriculum projects. During the week of December 8-12, 1975, a group of seventy-three consultants met at the Foundation's Directorate for Science Education in Washington, D.C. to form panels to examine critically the products of these nineteen projects* and the assumptions used in their development. The consultants represented a broad spectrum of interests and experience with pre-college curricula.

The charge to the panelists was spelled out in a letter dated October 23, 1975, from Dr. Harvey Averch, Acting Assistant Director for Science Education, to the directors of the projects to be reviewed. Dr. Averch outlined the review plan and noted that it should be based on the objectives as stated in the original project proposals, the progress achieved, and the products available at the time of the review. Arrangements were made for all materials of the projects to be made available for the review.

Dr. Averch's letter stated:

> "This review is also responsive to the Congressional directive from the House Appropriations Committee (House Report 94-313) in reference to our 1976 budget. This directive states that we must develop a clear statement of national needs and a clear rationale for those curriculum projects we wish to carry to the implementation phase. Our review is intended to help us develop the required statements of need and the associated rationales. In addition, the House Science and Technology Committee, which authorizes the Foundation programs, is engaged in a review of the Foundation's overall pre-college curriculum implementation policy (see House Report 94-44). Thus, we need systematic information on the status of all projects.
>
> "The National Science Board (NSB), our chief policy-making body, also directed in June 1975 that 'prior to undertaking full-scale dissemination and assistance activities for NSF-developed materials, NSF should undertake a careful review

* Of the 19 projects to be reviewed, 16 were active and 3 were technically complete, but no contract had as yet been negotiated with a publisher.

to insure that the proposed subject matter fits within reasonable limits or norms with respect to educational values and that the scientific content is accurate'."

Seven panels were formed to perform the review. One panel dealt with each of the areas of: elementary mathematics projects, secondary mathematics projects, and social science projects. Because of the large amount of material to be covered, three panels dealt with secondary science projects. The seventh panel consisted of publishers of elementary and secondary school science curricula.

Advance notice of the panel meetings was published in the Federal Register November 21, 1975. The meetings were subject to the terms of the Federal Advisory Committee Act, and were open to the public.

The remainder of this document and Appendices A and B describe the processes, procedures and results of this evaluation.

B. PREPARATORY PROCEDURES

Between October 23 and December 8, 1975, when the seven panels were convened, nine major planning steps were taken. A detailed description of these procedures can be found in Appendix B.

1. Identify and Contact Organizations for Panelist Recommendations

In all, 55 organizations were asked to recommend panelists for the review. As required by the National Science Board these organizations could provide a wide variety of experts, including (1) scientists, (2) mathematicians, (3) science and mathematics educators, (4) other professional educators including supervisors and administrators from public and private elementary and secondary schools, (5) child and adolescent development specialists, (6) representatives of the private publishing industry, and (7) members of the informed public, including parents and other lay citizens as well as school board members. In addition, students were recommended by local school administrators.

2. Assign Projects to Each Panel

Projects were assigned to one of seven panels depending on several criteria. This assignement permitted specialists to concentrate on those projects that had commonality and also allowed a reasonably equal distribution of the workload among the panels. Several panels were assigned to review especially complex curricula. One panel, made up entirely of representatives from the publishing industry, was asked to critically examine the two projects with publishing contracts but not yet completed. Project assignments to panels are shown in Table 1.

Table 1: Assignment of Projects to Panels

Panel 1: Elementary Mathematics Projects

1. Unified Science and Mathematics for Elementary Schools (USMES)
2. Problem-Solving Strategies and Applications of Mathematics in the Elementary School (MPSP)
3. ~~Project for the Mathematical Development of Children (PMDC)~~
4. Arithmetic Project (AP)
5. Madison Project Films (MMP)

Panel 2: Secondary Mathematics Projects

1. Sourcebook in Applied Mathematics (SAM)
2. Creation, Testing and Dissemination of Problem-Solving Instructional Materials (PSIM)
3. Development of a Mathematical Program for Grades 7-8 (MP78)
4. Mathematics Resources Project: Topical Resources for Middle School Mathematics Teachers (MRP)
5. First-Year Algebra via Applications Development Project (FYA)

Panel 3: Secondary Social Science Projects

1. Exploring Human Nature (EHN)
2. Human Behavior Curriculum Project (HB)
3. High School Political Science Curriculum (CPE)

Panels 4, 5, 6: Secondary Science Projects

Because of the complexity of some of these projects, some were assigned to more than one panel.

1. Technology, People , Environment (TPE) - Panel 4
2. Individualized Science Instructional System (ISIS) - Panels 4, 6
3. The Biomedical Interdisciplinary Curriculum Project (BICP) - Panels 4, 5
4. Four Motion Pictures in Social Biology (SB) - Panel 5
5. Outdoor Biology Instructional Strategies (OBIS) - Panels 5, 6
6. Human Sciences Program (HSP) - Panel 5

Panel 7: Publisher's Panel

Because of possible conflicts of interest, the publisher's panel was asked to review only those curricula that already had contracts with other publishers. Only two of the nineteen projects met this criterion:

1. Individualized Science Instructional System (ISIS)
2. Technology - People - Environment (TPE)

3. Identify Number of Members for Each Panel

In order to insure adequate representation from each of the group speci- fied by the National Science Board and permit the broadest range of expertise, it was agreed that each panel should have between 10-13 members. The one exception was the publisher's panel whose membership consisted of four representatives of the industry.

4. Select Panelists

Forty-two organizations decided to nominate panelists. Using the lists supplied by the organizations, prospective panelists were contacted via telephone to identify their level of interest. Prospective panelists were called in the order recommended by the organizations. When organizations did not rank order their nominees, NSF staff members attempted to match prospective panelist's skills with panel needs. In some cases, further contact with organizations was needed to identify additional participants.

A listing of the panelists is found in Appendix A.

5. Identify Questions for Panel Focus

To aid panelists in the review, the Science Education Directorate staff compiled a list of ten questions, the answers to which would aid the Directorate in planning future efforts with respect to the nineteen projects. These were:

1. Is there a genuine need for these instructional materials?

2. Is there a market for these instructional materials?

3. Do these instructional materials possess a clear purpose and rationale?

4. Is the content of these instructional materials scientifically correct?

5. Is the content of these instructional materials educationally sound?

6. ...e the proposed and anticipated outcomes of the instructional materials desirable?

7. Do these instructional materials present implementation problems for the schools?

8. Are the costs for implementing these instructional materials reasonable?

9. Is the management/organization plan adequate for producing these instructional materials?

10. What are your general impressions of the curriculum? What are your personal feelings about the values, content, approach and possible use of these instructional materials? Would you make any recommendations to the project staff, for example, instructional material revision, dissemination or management plan?

In addition to the ten basic questions, sub-questions were generated to aid penalists in the review. Furthermore, the publishers also addressed a specific set of questions concerning the impact of NSF curricula developmetn and implementation activities on the publishing industry. A copy of the final questionnaire is presented in Appendix B, as are the special publisher's questions.

6. Inform Project Directors of Each Project of Review Process

On October 23, 1975, Dr. Averch sent a letter describing the forthcoming review to the directors of the sixteen active projects. On November 4 a similar letter was sent to those project directors whose projects were technically completed but without publishers.

7. Request Additional Project Information from Project Directors

On November 11, 1975, Dr. Averch requested by letter that each project director respond to the ten review questions. Additionally, project directors were requested to be available during the week of December 8-12 to answer questions from panelists by telephone.

8. Design Format to Insure Adequate Review

The product of the review was to be a set of written responses to the first nine general questions for each curriculum and panel, together with individual panelists' responses to the tenth "general impressions" question To facilitate this process, panelists were formed into sub-groups (usually 2-3 members) to draft written responses to each question. These drafts were then submitted to the full panel for discussion and approval. If disagreement persisted after discussion, the panelists were free to submit dissenting reports.

9. Forward Pre-Panel Meeting Information to Panelists

Prior to the Washington meeting, each panelist was sent representative materials to review. Included were:

1. A descriptive summary of the project;

2. A copy of the project director's responses to the ten review questions;

3. Representative products from the project.

Complete sets of materials produced by the project to that point in time were available for review and inspection during the meetings in Washington.

C. PANEL MEETINGS

After an introductory session led by Dr. Averch, individual panels met to review their assigned curricula on the morning of December 8, 1975. Advance notice of the panel meetings published in the Federal Register of November 21, 1975, announced them as open to the public.

Each panel was assigned a facilitator who was a staff member of the National Science Foundation whose normal assignment did not include the monitoring of grants for the development or dissemination of pre-college science curricula.

Each panel was provided with at least one complete set of the curriculum materials it was to review. In addition, the following materials were available for review:

1. The complete original proposal submitted by the grant applicant to NSF, plus addenda that may have been submitted in the award process.

2. Awarded proposals and addenda to fund dissemination and training activities with respect to developed curricula.

3. Curriculum conference reports.

4. Developer's and NSF progress reports.

5. Existing NSF formative and summative evaluations.

6. Third party formative and summative evaluations.

7. Memoranda and correspondence between NSF program officers and project directors.

8. Project progress reports.

Communications between panel members and project directors and NSF program managers provided further information on each project.

Sub-groups of each panel drafted initial responses to each of the first nine questions, and presented them to the full panel. Drafts of each panel report were prepared by the end of the meetings on December 12th. These were subjected to final editing by the panel facilitators, and

then circulated to each panelist for comment. One panel (Panel 3) held an additional meeting on January 24th in order to complete its work.

The final reports of the panels are presented in the next section, together with descriptive material on each project, the project director's own responses to the review questions, and individual panelists' responses to question ten. The panel reports have been edited slightly for punctuation, spelling, and format, and have been retyped. Following final preparation and typing of the report, each panelist and project director was asked to certify formally the correctness of his or her contribution, although one panelist who was out of the country could not be reached. An effort was made to enter corrections,* but the National Science Foundation takes responsibility for any errors that persist. These reports are thus entirely the work of the panelists themselves, and not NSF staff. They represent an attempt by NSF to have a broad, independent evaluation done of an important program.

* Numbered footnotes are accumulated at the end of each section.

D. REPORTS OF THE CURRICULUM REVIEW PANELS

D. 1. a: USMES: NSF Descriptive Information

PROJECT TITLE: Unified Science and Mathematics for Elementary Schools (USMES)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Professor Earle L. Lomon

INSTITUTION: Education Development Center, Inc.

BUDGET: Total Granted: $2,567,194

Dates: 1/21/70 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: The USMES project is developing, for use in elementary schools, 32 interdisciplinary units which provide opportunities for students to learn the process of solving practical problems while acquiring relevant skills. Activities revolve about units called "challenges" which present practical problems feasible for consideration by children through in-depth investigation.

PROJECT SUMMARY

OBJECTIVES

Project Goals. Since its inception in 1970, USMES has been developing and carrying out trial implementations of interdisciplinary units which are based on long-range investigations of practical problems taken from the local school and community environment. The development work is carried out primarily by classroom teachers, assisted occasionally by university specialists. In responding to these real problems, called challenges, students are involved in all aspects of problem solving: observation, collection of data, representation and analysis of data, formulation and trial of successive hypotheses, and decision on a final action to be taken. In the course of this involvement, students are called upon to apply, extend and integrate learnings in mathematics, science, social studies, and language arts.

The goal of the project is to develop and conduct implementation trials of 32 units to serve as examples of the real problem-solving style of learning. The units are to be models and the impetus for this process to be taken up as a continuing effort in schools, but they will also be sufficient in number for school planners to design a flexible core activity for grades one to eight in which real problem solving plays an important role.

ACTIVITY PLAN

Progress of the Project to Date:

a) Development of Challenges. By 1975, development work had progressed on 27 challenges as follows: 11 were completed and available for wide-scale implementation, 7 were undergoing trial implementation, and another 9 were under development during the 1974-75 school year.

Among those completed are challenges entitled Pedestrian Crossings, Describing People, Play Area Design and Use, and Consumer Research/Product Testing. Challenges under trial implementation include Ways to Learn, School Zoo, Classroom Design and Bicycle Transportation. Some citles of challenges in initial development are Design Lab Design, Nature Trails, Mass Media, School Rules and Decision Making and School Supplies/School Store.

b) USMES Resource Materials. Since all activities in USMES units are initiated by the students in response to a long-range challenge, all USMES materials may be categorized as resource materials. For example, the Design Lab or its classroom equivalent provides tools and supplies so that children can carry through on their ideas by constructing measuring tools, testing apparatus, models, etc. The "How To" Cards are also a resource for the student. Each set of cards gives information about a specific problem; the student reads a set only when he wants help on that particular problem.

Teachers are provided with several types of resources: the USMES Guide, Teacher's Resource Books for the challenge unit being worked on, background papers, and a Design Lab Manual. Copies of all USMES materials for teachers and students comprise what is called the USMES library.

Future USMES Activities: The project plans to bring another 5 or 6 challenges into classroom development during the 1975-76 school year. Preliminary polling of teachers has led the Project to propose challenges around (1) Planning a Trip, (2) After School Activities, (3) Making the Community Attractive, (4) Helping Birds/Animals Survive, and (5) Community Gardening. The Planning Committee, meeting with groups of teachers will continue to explore and refine ideas for these final challenges. Also during the 1975-76 school year the 9 challenges currently in initial development will go into trial implementation and should be ready for wide-scale implementation in 1976-77. During the 1976-77 school year the last 5 challenges will go into trial implementation and should be available for wide-scale use in 1978, which is the final year of funding for the USMES project.

Work is under way and will be continued on a new format design for the Teacher Resource Books in order to increase their utility to teachers new to USMES. New "How To" card prototypes for younger children will be designed, produced and tested in 1975-76. This redesign results from data obtained from the Boston University evaluation (and from NSF's evaluation) indicating that the resource books are too cumbersome and complicated and need streamlining to be of greater use. The same evaluation has pointed to the fact that children in the primary grades (1-3) are unable to use the "How To" cards in their present format.

The background papers for teachers will also be rewritten to improve their usefulness. The Curriculum Correlation Guide, sample sections of which are currently available, will indicate how USMES units can lead into and grow out of other curriculum materials and topics. Model Program Schools, where more than half the classes are doing USMES, are providing documentation on intensive use of USMES in the school program. The first issue of the Journal of Real Problem Solving in Education, edited by USMES staff, will appear in spring 1976. Made up of articles by educators across the nation, the journal provides information on making USMES-type programs an integral part of educational programs.

ORGANIZATION AND MANAGEMENT:

The Development/Implementation Trial Process. In the USMES program, units are developed by teachers and students. Ideas for challenges are discussed at brainstorming sessions and then tried out with students. If the challenge appears to be a real problem involving adequate opportunities for cross-disciplinary investigations, teachers, with help from university specialists, work on it further at a workshop and with their classes. The initial idea may be rejected, modified, narrowed or broadened according to this early student input. The revised challenges are then tried out in other classes. Both stages of classroom trials are monitored through teachers' and observers' reports on class activities. These reports are the basis for the written resource materials. By the time USMES units are ready for implementation, documentation has shown that the challenges motivate students and elicit productive learning experiences. In addition, the resource materials have been developed to fit needs that have been expressed by teachers and students.

UTILIZATION PLAN: See "Objectives" and "Activity Plan".

HISTORY AND RELATED PROJECTS:

Origins. The Unified Science and Mathematics for Elementary Schools (USMES) Project was initiated in response to the recommendations of the 1967 Cambridge Conference on the Correlation of Science and Mathematics in the Schools. The conclusion of most participants at that conference was that the important objective of science and mathematics education for the population as a whole is to increase the efficacy of individuals in making decisions which affect their own lives and society. This requires that students learn the process of modeling a problem, search out facts and concepts that may be adaptable to a situation, and develop confidence in the method employed. Tackling recognizably real and practical problems in which the students themselves could make some headway was seen to be a way to accomplish this objective of applying science and mathematics to real life situations.

The Conference strongly urged that the solving of real, practical problems become a central activity of elementary school education. Since 1970, NSF has been supporting the USMES project at Education Development Center (EDC).

The USMES project has been developing interdisciplinary units with all the materials, resources, teacher education methods and organization features needed for effective implementation.

In addition, a variety of materials is provided for use by individuals or teams of resource personnel who are involved in implementing USMES in their local districts. Preparing People for USMES: An Implementation Resource Book provides information on conducting (1) in-service workshops for teachers to prepare them for using USMES in the classroom, (2) USMES informational meetings, and (3) Design Lab manager training sessions. A slide-tape show covering the USMES philosophy and selected units and videotapes of talks and discussions of the USMES style of learning and of classroom and design lab activities are also available for local dissemination activities. The project also produces an informational brochure describing the USMES program and distributes a quarterly newsletter.

PERSONNEL:

1. USMES Project Headquarters Staff at EDC: The Project Director is Dr. Earle L. Lomon, Professor of Physics at M.I.T. Dr. Lomon was a participant in the original Cambridge Conference held in 1967. The Associate Director for Development is Betty Beck. The Associate Director for Utilization Studies is Thomas Brown. The Associate Director for Administration is Quinton Baker. Their backgrounds are in science, education, and community programs.

2. USMES Planning Committee: A key component of the USMES project organization has been the Planning Committee. This committee provides an infusion of ideas into the project, a review of project operations, and a source of quasi-independent evaluation of the materials and practices produced by the project. As of 1975 the committee members were: Mrs. M. Bates, Advisory Council for Basic Studies, Office of Education; Professor D. Betando, California State University, San Jose (Industrial Studies); Professor J. Borsting, Naval Post Graduate School (Operations Analysis); Dr. Ludwig Braun, Computer Sciences, State University of New York, Stony Brook, New York; Mrs. C. Fano, Mathematics Teacher, University of Chicago Laboratory School; Professor A. Flexer, University of Colorado (Biology); Dr. A. Holden, formerly with Bell Telephone Laboratories (Chemistry); Dr. Fred Johnson, Science Consultant, Shelby County Public Schools, Memphis, Tennessee; Professor C. Kohn, University of Iowa (Geography); Dr. I. Morrissett, University of Colorado (Economics); Mr. F. O'Brien, M.I.T. (Design Laboratory), Cambridge, Massachusetts; Dr. H. Pollak, Bell Telephone Laboratories, New Jersey; Dr. Audrey Robinson, Adams School, Washington, D.C.; Mrs. M. Szlachetka, Teacher, Northwestern Elementary School, Lansing, Michigan; and Professor J. Werntz, University of Minnesota, Center for Educational Development (Physics).

D.1.b: USMES (Panel 1): Project Director's Response to 10 Review Questions

I am pleased to have the opportunity to comment on the issues being considered by the panel reviewing USMES. I am sorry that my letter has not been able to meet your November 24 deadline, but hope that it may still be useful.

It is perhaps worth noting for the panelists that much of the documentation they will need is summarized in a few documents. The basic philosophy and strategy of USMES and identification of the need it fills were outcomes of the 1967 Cambridge Conference on the Correlation of Science and Mathematics, all of which is documented in the report of that conference.[1] The delineation of the educational strategy as it was developed and a further analysis of the approach based on experience and cognitive research are presented in a review by project personnel published in 1975.[2] The project's overall system approach to development of strategies and supportive materials for the classrooms, the school systems, and teacher trainers is described in a document submitted to the National Science Board in 1974.[3] The up-to-date description of the USMES curriculum as presented to teachers and students can be found in any of our most recent series of teacher resource books[4], especially in the Preface, Introduction, Section A on Real Problem Solving and USMES. In addition, the Appendix in each book identifies the skills, processes and concepts that may arise in work on that particular challenge. Finally, the evaluation of the project during its development is reviewed and referenced in concise form.[5]

As a statement on real problem solving and as a reference point for all the discussion which follows, I quote from the Teacher Resource Books:

> USMES is based on the beliefs that real problem solving is an important skill to be learned and that many math, science, social science, and language arts skills may be learned more quickly and easily within the context of student investigations of real problems. Real problem solving, as exemplified by USMES, implies a style of education which involves students in investigating and solving real problems. It provides the bridge between the abstractions of the school curriculum and the world of the student. Each USMES unit presents a problem in the form of a challenge that is interesting to children because it is both real and practical. The problem is real in several respects: (1) a solution is needed and not presently known, at least for the particular case in question, (2) the students are involved in complete situations with all the accompanying variables and complexities, (3) the problem applies to some aspect of student life in the school or community, (4) the problem is such that the work done by the students can lead to some improvement in the situation. This expectation of useful accomplishment provides the motivation for children to carry out the comprehensive investigations needed to find some solution to the challenge.

That is what the USMES project is trying to develop as a mode of learning to be used substantially and widely in the schools. All of the questions addressed by the panel should be viewed in that light.

Question 1: Is there a genuine need for these instructional materials?

In 1967 a group of educators, scientists and mathematicians, with considerable experience in the curriculum reforms of the previous decade, met to discuss some needs which had not been met by the traditional or new programs.[6] The new programs, like the old, did not show the relationship between the real world and different subject areas, such as the social and natural sciences. They did not demonstrate the way in which concepts and processes from those subject areas, together with the basic skills of communication and computation are brought to bear on solving personal and societal problems and bettering the human condition.

Citing the "many problems enter(ing) the social and political arena which require deep scientific understanding," the conferees asserted that:

> "...Our political leaders need both scientific understanding and the support of a scientifically sophisticated electorate to decide wisely...A majority of adults today feel confused or threatened by everything scientific or mathematical. Our goal must be to correct this unfortunate state of affairs, and that was the objective agreed to at the conference. We specifically rejected the idea that we were trying to speed up the training of our scientifically talented youth or were aiming only at the college-bound child.
>
> "Most of our thinking was therefore directed toward the elementary school program. High school courses in mathematics and science are often elective. Changes here affect only the minority, whereas changes in the elementary school curriculum affect almost everyone."[7]

Going further, they identified the need for a learning mode (and related teaching strategy) rarely present in the schools. They suggested:

> "...including in the curriculum units that appeal to direct, obvious, and relevant experience. In applying the cognitive style often called the "scientific method" to interesting situations in everyday life, one may hope to remove some of the academic flavor of mathematics and science. The use of everyday situations may encourage children who resist abstraction or are impatient to see the relevance of what they are learning. Finally, broadening the style of the units will make it more likely that every child will be good at something, enhancing the probability that the child gains self-respect and can identify himself with the subject matter and its style."[8]

In identifying the above needs, the conferees were relying on their experience with students in elementary and secondary schools and in higher education. However, in 1970 the National Longitudinal Study of Mathematical Abilities (Begle and Wilson) confirmed that at least in mathematics, the disciplinary structure and content oriented new mathematics was not accomplishing all that was hoped. The new mathematics in the SMSC form was improving comprehension, application, and analysis for the top third of students at the expense of computational ability for the lower two-thirds. Formal and rigorous modern texts were producing poor results on all fronts.

It is worth noting that the view of this conference was to be taken up and expanded upon by many others by the early '70's. In 1971, Jerome Bruner[9] reviews his concern and that of others with the inadequacy of the educational program as it existed in the 60's, both the traditional and the reform curriculum.

"The movement of which The Process of Education was a part was based on a formula of faith: that learning was what students wanted to do, that they wanted to achieve an expertise in some particular subject matter. Their motivation was taken for granted. It also accepted the tacit assumption that everybody who came to these curricula in the schools already had been the beneficiary of the middle-class hidden curricula that taught them analytic skills and launched them in the traditionally intellectual use of mind.

"Failure to question these assumptions has, of course, caused much grief to all of us.

"...In my view, through my perspective, the issues would have to do with how one gives back initiative and a sense of potency, how one activates to tempt one to want to learn again. When that is accomplished, then curriculum becomes an issue again--curriculum not as a subject but as an approach to learning and using knowledge.

"...No, I really believe that our young have become so isolated that they do not know the roles available in the society and the variety of styles in which they are played. I would urge that we find some way of connecting the diversity of the society to the phenomenon of school, to keep the latter from becoming so isolated and the former so suspicious.

"...We might better concern ourselves with how those problems can be solved, not just by practical action, but by putting knowledge, wherever we find it and in whatever form we find it, to work in these massive tasks. We might put vocation and intention back into the process of education, much more firmly than we had it there before."[10]

These issues have had much more explicit discussion recently in reference to high school age youth. Five different reports of special studies made by national panels and commissions[11] conclude that one should reduce the age and cultural isolation of high school students.[12] Four of the five reports agree[13] that one should stimulate more non-student roles within the high school and develop closer ties with the community for planning, use of community resources and for work opportunities.

The report of the Panel on Youth of the President's Science Advisory Committee (PSAC) begins with an historical perspective pointing out that in early American education, "the dominant institutional settings within which they (youth) grew up were the home and the workplace." As formal education became necessary due to the rapidly changing occupational structure, "schools and colleges have come to provide the general social environment for youth.... The school system, as now constituted, offers an incomplete context for the accomplishment of many important facets of maturation." The panel infers that "it is now time for a third phase of society's treatments of its young, including school but neither defined not limited to it." The report then recommends a large variety of options that should be available to youth providing "environments explicitly designed to develop not only cognitive learning but other aspects of maturation as well." The report of the National Commission on the Reform of Secondary Education provides a similar analysis and conclusions.

In particular, the first report calls for education that develops "cognitive and non-cognitive skills necessary for economic independence and for occupational opportunities," "capability of effective management of one's own affairs," "capabilities as a consumer," and "capabilities for engaging in intense concentrated involvement in an activity," and for providing "experience with persons differing in social class, subculture and in age," "experience of having others dependent on one's actions" and a context of "interdependent activities directed toward collective goals."

Real problem solving as developed by the USMES project is designed to help fulfill all of the above aspects and there is accumulated evidence that it does so. If so, it helps in the PSAC panel's aim "to stimulate the search for institutional inventions which will insure that youth acquire the capabilities for fulfilling the demands and opportunities they will confront as adults, and thereby gain the self-esteem and self-fulfillment all persons need." While the panel was convened to consider secondary education, the goals are the same for younger children, and it is well recognized that the task of secondary schools is much more achievable when they begin with youngsters whose attitudes and skills are appropriate to the goals of the overall educational program. Furthermore, while alternatives to a school setting may be realistic at the secondary level, they are not likely to be acceptable before the age of 14. Hence, a program like USMES is one of very few options to bring young students into contact with adults, with societal concerns and with the means to be effective in the dealing with practical problems.

One may question whether learning through investigation and action on real problems is a desirable educational activity for the wide range of students affected in elementary schools. The conviction that improvement in problem solving process abilities is needed by most of the population arises from an analysis of recent history. The rationale is discussed in the paper on real problem solving in USMES.

> The very success of the human species has led to growth in population, a depletion of resources, an intricacy within the society, and a rapidity of change which confronts our minds with many difficult dilemmas. Finding our way out of these dilemmas demands a very high degree of flexible, sophisticated real problem solving ability at all levels of population. Having a few expert problem solvers at the helm will not do. It is in the nature of our individualistic, yet highly interdependent, society that the health of the society depends on the responsiveness (and responsibility) of many people; the individual cannot leave his happiness in other people's hands. Thus, most of us must become good solvers of real problems.

It is important to note that learning through real problem solving is a need recognized by a wide variety of education interests. The interest from the point of math, science and social studies educators is fairly well known. Extending this to the viewpoint of technology, Harold A. Foecke, Director of the Division of Pre-University Science and Technology Education[14] said, "In terms of the two processes to be understood (the scientific and the problem solving), it seems to me that the problem-solving or decision-making process is of much more direct importance to the average citizen." The Industrial Arts and Career Education fields have also recently expressed a need to integrate their subjects with the core subjects. Real problem solving is a vehicle for this.

Perhaps least expected of all, the need for better reading and writing skills, which needs no justification here, can be well served by action oriented education programs. A summary of relevant research has been provided by Professor Mary Budd Rowe of the University of Florida.[15] USMES is no exception to this effect as will be discussed later.

Question 2: <u>Is there a market for these instructional materials?</u>

There is no developed curriculum other than USMES that is designed to satisfy the needs for learning through investigation and action on real problems. The acceptance of the program among professional educators, the rapid rate of classroom adoptions[16] for a still developing curriculum and the evidence of the effectiveness of the curriculum for a wide spectrum of students in grades K-8 (to be discussed later) indicate that there is a very large possible market for USMES.

There are two major obstacles, however, to easy fulfillment of near maximum utilization of the program. The first stems from the interdisciplinary and open nature of the USMES learning process. Those aspects are no hindrance to the use of the USMES curriculum as such, USMES may become widely utilized and have substantial importance to education, but will lack the classroom time necessary to have the major effect on the learning of our children required by the profound

needs described above. However, the fuller use of USMES requires adapting the overall school program to enable the integration of USMES with the subject-oriented curricula, in order to share time with other modes of learning. It also requires the adoption of new student assessment and grading procedures that take into account a greater range of cognitive and affective learning, and a greater variability when each child acquires a skill, process or attitude. USMES is currently working on several ways to meet this problem, by charting the things that can be learned in each unit,[17] by comparing units to learning that can be achieved,[18] by preparing a curriculum correlation guide, and by working with schools having programs that use USMES in an integrated and intensive way. There is already evidence from several schools that this can be done successfuly and documentation of these results will enable other schools and school systems to adapt successful model programs to their own use.

The second hindrance to widespread utilization stems from an apparent asset. There are no textbooks, only resource material for teachers and "How To" Cards for the use by children in the classroom; hence the program is not costly. A school with about ten teachers using USMES at one time would require no more than $150 worth of printed materials. Even adding about $200 per year for the tools and materials of an USMES Design Lab leaves the program very cost effective. The fly in the ointment is that the potential low volume of sales (no textbook for every student) has resulted so far in the lack of a bid from a publisher. Alternatives exist, such as direct sale to city or state school systems, or licensing for printing by such systems or through existing professional organizations. All possibilities are being pursued, including continued contact with publishers, with some success being attained in direct sales and adoption agreements with states and cities. The advantage of those means of delivery is a much reduced cost to the consumer from using the many information and communication channels of the education establishment. The advantage of a publisher is the long-term incentive of the publisher to distribute the materials. This is not a simple problem, nor will the choice be easy if more than one alternative proves to be feasible. We will continue to explore the distribution situation in close cooperation with the policies and advice of NSF.

Question 3: <u>Do these instructional materials possess a clear purpose and rationale?</u>

The purpose of the USMES curriculum is to meet the needs described in answer to question one. Most importantly, it is to produce in our students the ability and the desire to solve problems (personal and societal) and to be effective contributors to the complex decision making process of today's world. This includes becoming effective users of basic communication and calculation skills as well as having the subtler problem solving process abilities and positive attitudes towards self and society.

The rationale for USMES being an effective vehicle for such extensive goals was first stated in the Report of the 1967 Cambridge

Conference, and later restated in the article, "Real Problem Solving in USMES: Interdisciplinary Education and Much More." An independent statement expressing a very similar rationale is offered by Foecke:

> The fundamental educational principle is that processes like research or design are not learned by reading books about them, or listening to lectures, but by practice--ideally under skillful supervision. Hence, in my opinion, in teaching both science and technology, the most important (but, of course, not the only) form of learning experience would be direct student involvement in the processes--at a level of sophistication appropriate to the child.
>
> How early can these processes be taught? I do not know--and I do not know whether a lot of research has been done to determine whether there are stages of mental development below which the child cannot understand these different processes. Certainly our efforts to teach the rudiments of the inquiry method of science at the beginning elementary levels seem to imply an assumption that the essence of this method can be comprehended at these early ages. If this be true, I would hypothesize that the design (or decision-making) method can be learned as well and one could therefore try to teach both processes in an integrated programme for science and technology.
>
> ...The heart (but not necessarily the bulk) of the programme would involve confronting the student with "realistic" (and, where possible, real life) situations, with the level of complexity scaled to the level of the student's development, in which he could gain direct, personal experience with the separate processes of seeking knowledge (research) and problem solving (design).[19]

Fortunately there is some explicit research to support the above rationale. Robert Gagne who is best known for his work on structured and hierarchical learning processes found that those methods were not suitable for the higher level "cognitive processes" which he identifies with problem solving. In 1971 he wrote two articles on the results of his research.[20] The conclusions are summarized in Table 1 of "Instruction Based on Research in Learning" where the types of learning are categorized as "verbal information," "intellectual skill" and "cognitive strategy." For the first category he finds that "organized verbal context" is an effective condition of learning and for the second category "the combining of subordinate (prerequisite) skills." But for "cognitive strategies" he finds that "successive encounters with problems requiring productive thinking" is the required condition. The last is the USMES strategy in a nutshell.

The research reported by Mary Budd Rowe[21] substantiates a further aspect of the USMES rationale. The more structured type of cognitive skills are also furthered by the more open, involved and active modes of learning. Evaluation of the USMES project (see response to question 5)

corroborates that the real problem solving mode of learning is no exception. It also improves the rate of learning basic skills to the extent discernible by the study.

Question 4: Is the content of these instructional materials scientifically correct?

The project, from the beginning, has had its materials under the continuous scrutiny of social and natural scientists and mathematicians. The majority of the USMES Planning Committee are distinguished members of those fields, and every development and workshop team has college level content and curriculum specialists as staff or consultants. In addition the Project Director, the Associate Director for Development and some editorial staff have a science background. Thus, the material has been checked for scientific accuracy many times before distribution for implementation trials.

It is an important policy of the project that only real data is used and that all the resource material is based on actual classroom events or experiments. This serves the dual purpose of ensuring the practicality and feasibility of all of our resource materials and the accuracy of the statements in the context in which they are made.

Most of the resource materials have been viewed by hundreds or even thousands of teachers and other educators. To date, no one has informed us of a scientific or social inaccuracy.

USMES is aimed at the broad spectrum of students in grades K-8. Therefore, its main purpose is to produce a scientifically literate population rather than specifically to train future scientists. However, "literacy" is taken to mean a good deal more than "awareness" of scientific methods and concepts. The thrust of the USMES curriculum is to produce individuals who are capable of applying their knowledge and rational thought to helping solve personal, business, political and other social problems that they will meet in any walk of life. It is assumed that a large part of the population must collaborate with specialists to solve the complex problems of today's society. Thus, accuracy of content as well as process in materials for the general populace is as important as it is in materials used in the training of future scientists.

Question 5: Is the content of these instructional materials educationally sound?

The evaluation of the instructional materials is still in process. Results to date from an independent Boston University evaluation program[22] support all the basic assumptions of the instructional strategy and indicate that the materials adequately support those strategies. Tests of real problem solving processes and abilities have indicated that USMES can have a positive effect, while none is discernible in the absence of USMES.[23] Results from standardized computation and reading tests indicate that USMES classes not only do as well, but probably better than, traditional classes in

the key area of basics.[24] Extensive interviews and classroom activity analysis have confirmed that the USMES program strongly and suitably affects attitudes and affective behavior.

No negative side effects on any part of the student population have been discerned so far. On the contrary, we have documentation of such variable cases as USMES being used with the gifted, the physically handicapped, the emotionally disturbed and at age levels from kindergarten to grade 8, with success.

The USMES program is particularly suitable for dealing with value laden issues, because it leaves them to be worked out by the children and teacher in the context of their own environment. An USMES "challenge" brings the students' attention to a problem recognized as one needing attention by people in the school or community. No direction is given by the resource material as to the values to be given to different aspects of the problem or of possible solutions. Instead the students are to inquire, sometimes by polling, concerning the interests and views of people who will be affected by their decisions.

The program makes no assertions about what are "right" or "wrong" solutions to a given problem. Instead, the test of the success of the students is the reaction of the public to whom they present their findings or from whom they wish to get help in implementing their conclusion. Perhaps these are the reasons why parents and community have generally been supportive of children's endeavors arising out of USMES challenges. We have yet to be faced with a problem of parent or public resentment of any facet of our program.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The broader issues raised by this question have been addressed in part in answer to earlier questions. It is worth noting two new aspects here. First of all, the open nature of the materials avoids sexual, racial, ethnic or religious bias or stereotyping. In fact, USMES challenges often ask the student to address and redress such problems. Moreover, in use the USMES program has proven to be equally popular and useful across sex, race, and social backgrounds.

The other point worth making here is that as USMES is more of a strategy of teaching than it is specific content, it can and does affect teacher behavior and school programs beyond the time in which USMES units are explicitly used. This is affirmed by the Boston University interview data as well as our own documentation.

Question 7: Do these instructional materials present implementation problems for the schools?

This question has been in large part answered earlier, particularly in the answer to question 2.

In one way, implementation of USMES is easier than implementation of more traditional programs. As the teacher can learn facts along with the student, teacher preparation does not have to extend already overloaded content courses. Attitudinal change and classroom strategy

is the key to successful teacher use and is built into our teacher preparation models and field trials.

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

The materials themselves (both written and Design Lab) are very reasonable, as has been indicated in answer to question 2. Teacher training for utilizing a very different program is needed. Our model--two week workshops-- is neither cheap nor particularly expensive. We are presently developing mass media approaches which may considerably decrease the cost of teacher preparation.

The problem of staffing the Design Lab may or may not be a large expense depending on the nature of the staffing already available at the schools. The presence of aides, student teachers, community volunteers, science specialists or others often takes care of this need without any extra staff. Otherwise, a cost effective way must be adapted to the school. The attached excerpt from the Design Lab manual describes the alternatives.

Question 9: <u>Is the management (organization) plan adequate for producing these instructional materials?</u>

The management/organizational plan is thoroughly addressed in "The USMES Systems Approach to Development, Widespread Implementation and Maintenance of a Real Problem Solving Program in Elementary Schools." The development and trial implementation of USMES materials are carried out in classrooms by teachers and students, with the help of university specialists at meetings and workshops. The staff at EDC coordinates these and other program activities and produces resource materials based on the regular reports received from the teachers in the field.

In the broadest sense, we have faced every issue as it has arisen and we believe we have a very effective organization at this point to accomplish our purposes.

Earle L. Lomon
USMES Project Director

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Footnotes

[1] Goals for the Correlation of Elementary Science and Mathematics, The Report of The Cambridge Conference on the Correlation of Science and Mathematics in the Schools, Education Development Center, Inc., Houghton Mifflin Company, Boston, 1969.

[2] Lomon, Earle, Betty Beck, Carolyn Arbetter, "Real Problem Solving in USMES: Interdisciplinary Education and Much More," School Science and Mathematics, Jan., 1975, pp. 53-64.

[3] "The USMES Systems Approach to Development, Widespread Implementation and Maintenance of a Real Problem Solving Program in Elementary Schools," March, 1974.

[4] Classroom Management, Getting There, Orientation, Using Free Time, School Rules, Mass Communications, School Supplies, Growing Plants, Nature Trails, School Zoo, Ways to Learn/Teach, Design Lab Design.

[5] "Evaluations of USMES: A General Report," Education Development Center, 1975.

[6] Goals, op.cit.

[7] Goals, op.cit., p.5

[8] Goals, op.cit., p. 30.

[9] Bruner, Jerome S., "The Process of Education Revisited," Phi Delta Kappan, September, 1971, pp. 18-21.

[10] Bruner, op.cit., pp. 19-21.

[11] The Greening of the High School, Weinstock, ed., New York: IDEA-EFL, March, 1973. American Youth in the Mid-Seventies, Conference Report, NASSP, December, 1972. Youth: Transition to Adulthood, Report of the Panel on Your Youth of the President's Science Advisory Committee, June, 1973, Chicago: University of Chicago Press, 1974. The Reform of Secondary Education, National Commission on the Reform of Secondary Education, July, 1973, New York: McGraw-Hill, 1973. National Panel on High Schools and Adolescent Education, U. S. Office of Education, March, 1974.

[12] The Emerging Reform Movement in Secondary Education, Working Paper from Conference Sponsored by Rockefeller Brothers Fund and Education Development Center, Inc., May, 1974.

[13] The Emerging Reform. . .op.cit.

[14] Foecke, Harold A., A speech to the International Conference on the Training of Teachers of Integrated Science (University of Maryland, April 4, 1973).

[15] Rowe, Mary Budd, "Help Is Denied to Those in Need," Science and Children, March 1975, pp. 23-25.

[16] See attached sheet on recent utilization of USMES.

[17] See charts in USMES Teacher Resource Books.

[18] See charts in USMES Guide.

[19] Foecke, op.cit.

[20] Gagne, Robert M., "Instruction Based on Research in Learning, Engineering Education, vol. 61, no. 6, March 1971, pp. 519-523; and "Domains of Learning," Interchange, Vol. 3, No. 1, 1972, pp. 1-8.

[21] Rowe, op.cit.

[22] Shann, Mary, Thomas Aiello, Norma Reali, "An Evaluation of USMES: Its Effects on Student Performance In Problem Solving and Basic Skills," A Preliminary Report for the National Science Foundation, September 1974.

[23] Shapiro, Bernard J., "The Notebook Problem," Report on Observations of Problem Solving Activity in USMES and Control Classrooms, May 1973.

[24] "Evaluations of USMES: A General Report," Education Development Center, 1975.

NOTE: Attachment mentioned in footnote 16 is available from the project director.

D. 1. c: USMES (Panel 1): Panel Responses to 9 Review Questions

UNIFIED SCIENCE AND MATHEMATICS FOR ELEMENTARY SCHOOL (USMES)

USMES seeks to provide a problem solving-based supplementary curriculum for children in grades 1 - 8 for the solution of challenges based upon "real" problems. The project began in 1969 and to date has generated in commercially prepared format 21 of the 32 challenges to be created.

The project has made available to the Review Panel all documents related to the project. The original proposal and following continuation proposals were reviewed. USMES teacher materials, student "How To" cards, slides of design labs and other instructional materials were examined. Internal and external evaluation reports were also utilized by the Review Panel. Implementation reports and discussion with the NSF project manager also served as a basis in preparing the following report.

Question 1: Is there a genuine need for these instructional materials?

A real problem is defined in the USMES curriculum project as one for which:

(1) A solution is needed and not presently known,

(2) The students are involved in situations with all the accompanying variables and complexities,

(3) The problem applies to some aspect of student life in the school or community, and

(4) The problem is such that the work done by the students can lead to some improvement in the situation.[1]

The USMES project was formed in response to the recommendations of the 1967 Cambridge Conference on the Correlation of Science and Mathematics in the schools. In addition, professional groups (NCTM, NSTA) have also supported the teaching of problem solving and problem-solving skills. Present curriculum materials do not have problem-solving as the major focus. Although present curriculum materials may provide limited opportunities for children to apply problem-solving strategies, they do not provide extensive applied problem-solving opportunities.

The USMES curriculum materials are designed to be used with children of varying abilities and differing socioeconomic and ethnic or racial backgrounds. The deciding factor here is really the teacher and administrators. The USMES materials can not be used independent of a teacher--they are not "programmed" for children to use independently of adult intervention. The materials developed are primarily teacher resource materials. Thus, the number of pupils these materials can

be expected to reach is directly proportional to the number of teachers and administrators who know the materials, can effectively facilitate the problem-solving processes, and have a commitment to teaching problem-solving skills.

There are no satisfactory alternative instructional materials in this area. Bits and pieces of problem-solving opportunities appear in major commercial texts and activity cards, but there is no cohesive curriculum currently available that does what USMES does, namely, provide a curriculum with practical problem-solving opportunities.

A project that provides opportunities for pupils to develop and use these problem-solving skills is needed and might also have long term benefits for participating students. The needs assessment provided by USMES considers this issue. National panel reports (Report of the Panel on Youth of the President's Science Advisory Committee), Conference reports (American Youth in the Mid-seventies, NASSP) and USOE publications (National Panel on High Schools and Adolescent Education) support the need for a real problem-solving curriculum.

Question 2: Is there a market for these instructional materials?

The problem-solving curriculum of USMES is unique. There is no curriculum project or set of materials that provides problem-solving challenges similar to USMES. The provision of units for grades 1 - 8 affords problem-solving resources across a wide age span for teachers and pupils.

The commercial market for a problem-solving curriculum of an interdisciplinary nature is not fully known. Mathematics, science, and social science programs that have a problem-solving component do exist. However, these treat particular strategies or techniques that may be useful in solving particular kinds of problems limited to a discipline. There is no set of curriculum materials that provides interdisciplinary problem-solving settings for grades 1 - 8.

The products that the USMES project has produced are teacher resource materials. The program was used with approximately 19,000 students in 719 classes in 1974-5 and the estimates for 1975-6 indicate an additional 14,000 students in 530 classes.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The goal of the USMES project is to develop and conduct implementation trials of 32 problem-solving units. The individual problems are clearly described and specified in the USMES materials and are based on long-range investigations of practical problems taken from the local environment.

Inherent in the materials is the notion that children learn problem-solving skills by involvement with a problem that is real to them. The materials are based on a belief that problem solving is an important skill to be learned and that much mathematics, science, social science and language arts may be learned within the context of student investigations of meaningful problems.

The materials are clear and easily understood and reflect the stated philosophy of the project. There are presently 21 units available for widespread implementation. Additional support material available to teachers includes an overall guide, resource books, a lab manual, "How To" cards, and background papers. These materials provide a cohesive package for the teacher who implements USMES.

The selection of challenges from the local environment provides for student as well as classroom teacher input. In this way challenges that are significant for students are identified for development.

Question 4: Is the content of these instructional materials scientifically correct?

Our own examination of the materials confirms the project director's statement that the materials are (to the best of our knowledge) accurate. The teacher resource books and the original and continuation proposals give evidence that specialists from science, mathematics and social science have been continuously involved in materials preparation and revisions.

It seems especially important when evaluating or using the USMES materials to keep in mind the portion of the curriculum to which they apply.

To some extent, the USMES "how to" cards provide practice on the intellectual skills or abilities children need to learn. But these are used on a need-to-know basis and thus give a non-systematic treatment of basic skills in science and mathematics. Teachers and administrators need to plan carefully about time allotments and topic selection to ensure a comprehensive treatment of basic skills. In addition, USMES project personnel should continue to give attention to the articulation of their materials with the mainline instruction used in schools. Assisting teachers in use of the charts of skills, concepts, and processes that accompany each resource book will help to avoid spotty treatment of disciplines. There is potential in the USMES units for disagreement about what is studied and how the study takes place. Advertisers, police chiefs, or manufacturers may not like the conclusions or recommendations that result from studying real problems. That chance is worth taking, however, provided schools, principals, teachers, and children exercise prudence and responsibility in attacking problems and are protected from undue harassment. In this way students may learn that practical problems can generate alternative solutions. Value

decisions are involved in the application of science and mathematics and final solutions often represent difficult compromises with no person or group totally satisfied.

Both English and metric measurement are used throughout the unit, but the bulk of the data in the Teacher Resource Books appears to be in English units. We found no "How To" cards that dealt with metric measurement. Because of the greater emphasis today on metric measurement, the project should consider conversion to that system.

The problem-solving and interdisciplinary nature of the materials gives learning opportunities for children of varying backgrounds and aptitudes. This learning should aid children who may become scientists but could also benefit children who choose other vocations.

Question 5: Is the content of these instructional materials educationally sound?

Our judgment is that instructional materials are sound if the goals are desirable and attainable, if the materials are suitable for helping students achieve the goals, and if adverse side effects can be minimized. The USMES materials meet these criteria.

There will almost certainly be problems when using USMES materials. Among these are: a) use of the materials with immature youngsters, b) problems in equipping and staffing the design lab, c) safety problems both in and out of school, and d) solutions to problems with which some persons may disagree (e.g., those in Consumer Research). Despite these problems, the potentially desirable outcomes of USMES outweigh the possibilities of adverse side effects. Provided that users exercise the care and attention described in various documents from the developers, the difficulties of adapting the materials to different types of youngsters and to different school systems seem reasonable and solvable.

A problem that needs attention in the Teacher Resource Books is that of how to deal with value-laden or publicly sensitive issues. These issues may arise in various units as children carry out their activities. We thought that the Consumer Research and Pedestrian Crossings Units were ones in which merchants and public officials might react negatively to the findings of children. Teachers and administrators should be alerted to this possibility and given some advice on how to deal with it. The project director reports no problems of public or parent resentment of any part of the program.[2] However, tryouts have been carried out with only a few select teachers. When those with less skill, less training, and possibly less enthusiasm use the materials that situation may change.

The challenges in the units we reviewed have the potential for giving students with different abilities and aptitudes the opportunity to display their strengths and work on their weaknesses. One child may be skilled in the Design Lab but have difficulty in graphing data. Another may be good at measuring and recording numbers but be less than adept when reporting findings. Thus, both students may have the opportunity with USMES materials to succeed with what they can do and to grow in those areas in which they lack skills.

The fact that precise strategies, methods, solutions, and procedures are not prescribed in the materials encourages teachers to adapt the challenges to their own community, school, and children. Sufficient guidance is given in using the materials through the presentation of data and anecdotal information to help most teachers get started successfully.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The USMES goals are ambitious. It is our opinion that they are also desirable. Various documents cited in the original proposal show the support for these goals by influential individuals and professional societies.

Several means have been used to document the achievement of these goals by students. The Evaluation of USMES[3] describes these effects through results on standardized tests, reports from teachers logs, third-party evaluations[4,5] and data gathered by participant teachers.

In general, students in USMES do as well or better on achievement measures than their non-USMES counterparts. It has, however, been understandably difficult to create valid and reliable situational measures of problem-solving and group interaction skills. Our judgment is that both internal and external evaluators of the project should continue to work on these instruments because of their value to the USMES project and other programs with similar goals. Attention should also be given to the development and validation of more easily administered paper and pencil instruments to measure problem-solving ability and student effect.

The Shann report does bring out some of the problems that arise with the USMES materials. Youngsters that are immature and undisciplined have difficulty working together and progressing on USMES challenges that are not carefully structured. Of course the hope is that the USMES experience might foster these skills. The immediate problem for the teacher, however, is contending with the individuals and groups in the hope that they are progressing. Frustration by such teachers is inevitable--perhaps to the extent that they could not and should not use these materials. It is our estimate that the proportion of teachers and students so affected is small but by no means insignificant.

No evidence of sexual, racial, ethnic, or religious bias was noted in the materials that we reviewed. The authors and developers were apparently sensitive to these problems and avoided them. This statement is based on less than a complete analysis of all materials and pre-publication scrutiny with appropriate guidelines (e.g., those developed for assessing bias of textbooks in California) should be done as the materials become finalized.

The USMES project personnel should be alert to a danger when the process of problem solving culminates in printed, "completed" sets of materials. An important goal of this project is to foster open, reactive, autonomous problem selection and problem-solving behavior by teachers and pupils. Curriculum materials developed with that intent may become rigid and fixed over time and original project purposes may become undermined. We saw no evidence of this happening with the USMES materials but wanted to point out the possibility of this occurring as time passes and materials are more widely used and firmly established.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

USMES training programs are based upon a simulation training sequence with participants doing the actual challenges that will be used by their students. Special training will be needed by teachers and administrators not only for the use of the materials but also for the strategy of teaching based upon a problem solving core. Three options are available to a district for training teachers by using models developed by USMES.[6]

1. A local district can accept the sole responsibility to provide resources.

2. A local district shares the responsibility for teacher training and program coordination with a college or university.

3. Regional resource teams can be developed to apply a "trainer of trainer" strategy for district schools.

One difficulty when implementing USMES materials is in finding suitable facilities to house a Design Lab. USMES suggestions offer good alternatives including the use of Design Lab Carts. USMES staff admits that problems concerning staffing a Design Lab may arise.

According to the available evidence, successful implementation on the district level has been associated with strong commitment and support by the district, a district person who is to be closely associated with the project, strong on-site administrative support, and design labs.

Question 8: Are the costs for implementing these instructional materials reasonable?

Estimates of cost per teacher for training in Chicago ($948) or Lansing ($969) were evaluated as moderate when considered on a cost per pupil basis.[7] However, the cost of implementing the total program is low since there are no individual pupil texts. Estimates of costs of printed materials are about $150 for 10 teachers. The cost of equipping the Design Lab ($1,000) may not be realistic for all schools. Alternatives to purchasing a complete Design Lab are suggested by USMES and include "scrounging" and local fund raising.

Estimated replacement costs of about $200 for printed and laboratory materials for 10 teachers do not appear to be excessive for second and subsequent years. Evaluation of the costs for training[7] pointed out a need for extending the training from a one-year program to a three-year program of training. Additional costs for extension of the training must be considered in the "replacement" costs.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

USMES is organized around a systems approach to development, implementation and maintenance.[8] The components of the system are organized into categories of project resources and programs. A system chart indicates the most important interactions among components and component categories.[8]

USMES has made a consistent effort for all interested parties to provide input into the development of the challenges. The local school development of the units provides a broad base of teacher and student participation in the design of materials.

Internal monitoring of the program has gone along with the development of the unit challenges. External monitoring of the program has substantiated that some of the goals of the program are being attained.[4] External monitoring has also indicated needed changes and revisions in assessment instruments directly related to measuring pupil performance on the problem solving assessment instrument.[4] Review of the evidence has shown a willingness on the part of the project personnel to make appropriate changes as noted by the external evaluations.[7] Possibly more attention should be placed in the recommendation to lengthen the training period of teachers to 3 years.

The project staff appears to be well balanced with respect to sex, race, and types of expertise. Documentation of project activities has been disseminated to NSF, to national organizations and to the lay public.

Our view is that the overall organization and management of the program have been adequate in directing the project toward the attainment of its goals.

Notes

1. USMES: Teacher Resource Book, ORIENTATION, June 1975 EDC.

2. Lomon, E., Information for panel reviewing the USMES project. Newton, Mass.: Education Development Center, 1975.

3. Evaluation of USMES: A general report. Newton, Massachusetts: Education Development Center, Inc., 1975.

4. Shann, M., Aiello, T., Reali, N., An evaluation of USMES: its effects on student performance in problem solving and basic skills. Boston: Boston University, School of Education, 1974.

5. Welch, W. and Ward, W., Evaluation report USMES implementation models, Lansing - Chicago, Minneapolis, Minnesota Research and Evaluation Center, University of Minnesota, 1975.

6. USMES - District based models of USMES implementation, June 1973, EDC.

7. Welch: Evaluation Report - USMES Implementation Models - Lansing, Chicago, Sept., 1975. Minnesota Research and Evaluation Center.

8. "The USMES Systems Approach to Development, Widespread Implementation and Maintenance of a Real Problem Solving Program in Elementary Schools" March 1974. EDC.

D. 1. d: USMES (Panel 1): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

NSF Staff Note: Panel 1 submitted a general response of the whole panel which applies equally to all five curricula reviewed by Panel 1. In addition, one panelist submitted an individual comment which applies equally to all five curricula reviewed by Panel 1, and one panelist submitted individual comments on each curriculum.

Panel 1's common response:

In addition to expressing its opinions on individual projects, the panel wishes to express itself on curriculum projects in general. The following paragraphs describe issues that the panel feels strongly about and which we believe the NSF must take seriously in their deliberations regarding the Foundation's support of curriculum development.

Long Range Implementation

The Review Panel expresses a concern with respect to all projects in the area of long range implementation plans. Projects must make provisions for long term teacher education programs with local school districts to insure proper implementation and use. Lack of adequate commitment to this issue in the past has led to misuse, misconception and a questioning of the actual value of the project itself.

A project must make provision in its design to work with local school districts in providing a systematic plan for implementation which is mutually acceptable and cost effective for both the project and the local school.

Projects must also consider the implications of teacher education programs at the university level if the project is someday to become widely used. This must be considered by projects if the teaching strategy employed is divergent from current practices and in light of the fact that the local schools will be the recipients of teacher education programs.

Parent Involvement

The school and the home have one common concern from the beginning--the child. Therefore, education of children must be a teamwork

effort. The child cannot be the victim of a tug of war over who knows best for the child, because the result is frustration for teacher, parent and child. Instead of the three R's, the three C's need to be implemented. There must be communication, compromise and genuine concern between home and school.

Parents should and must be included from the beginning when curriculum materials are developed. However, care must be taken to remember that parents are for the most part lay people and should not be overwhelmed with educational jargon. Their contributions are important not only because of their concern and knowledge about children, but also because they are free of any constraints imposed by involvement in the professional educational establishment.

Child Development

It is generally agreed that the most effective curriculum materials are those which are adapted to the developmental level of the children for whom they are constructed. This means that in any group attempting to construct new curricula, there should be one or more persons who are solidly grounded in the field of child development. This was not always the case in the projects reviewed by the panel. As a consequence avoidable errors in curriculum construction were made and potential insights into the worth of particular materials were lost or not fully appreciated. NSF should seek to insure that child development skills and knowledge are represented in government-supported curriculum projects.

Use of Supplementary Curriculum Materials

Each of the curriculum projects evaluated by Panel 1 is considered a "supplementary" program in the sense that they do not intend to replace or supplant established subjects or their entire arrays of curricular goals. For example, none is the mathematics program or the science program.

However, when these programs are truly integrated with or complement established subject and skills areas, someone must confront the difficult problems of interrelating the components. Projects, we believe, have some responsibilities in seriously grappling with these issues and providing guidance to schools that go beyond the narrow role of project implementation.

Development of process goals in problem solving behavior is a very important, and long neglected, objective of evaluation. However, other important objectives remain and should not be overshadowed. There

are certain emphases in, say, mathematical skills and concepts that inevitably result when the major focus is on the application of the subject to "real" problems. The important role of mathematics and scientific disciplines as a useful tool is stressed. The danger lies in the possible neglect of other aspects of the discipline. Those responsible for the curriculum should be certain that the unitary, systematic, structural nature of the subjects is not lost in the process. The knowledge and views obtained by the child should not be of disciplines as fragmentary bits and pieces however useful.

We merely state here that supplementary projects should not avoid responsibility for this difficult problem but should seriously award it continuous attention.

The Role of the Federal Government in Curriculum Development

The Federal Government clearly plays a leadership role in curriculum development, but the nature of that leadership needs to be carefully considered. For example, is it better to use federal resources to build programs at a regional and national level and then attempt to disseminate them to local school districts? Or would there be a better return by encouraging local school districts to improve their own programs through staff development and local curriculum projects that meet the needs of the community?

Teacher Involvement

The extent to which teachers are involved in the projects reviewed by the Panel varies greatly. Since elementary school teachers are the key to the effective outcomes of all projects for improved learning of children, the Panel strongly recommends that teacher involvement is necessary in all stages of planning, development, and implementation of the project efforts.

Representation of Women and Minorities

Project leadership and staff should be representative of a cross section of the educational community. Involvement of minority group members and women in the planning, development, implementation and governance or advisory tasks has been missing in some of these projects. Key personnel in at least two of the projects reviewed were almost exclusively white males.

In addition, it was also apparent that some key personnel were involved in more than one project. This overinvolvement of project staff not only limits the range of talents, abilities and insights available but also limits leadership of curriculum development to a small group. The panel believes that NSF should encourage project directors to have a broader representation of minorities, women and key professionals on curriculum projects than is apparent in these projects.

Panelist: Dr. James R. Okey

My only concern with our review is that we may have been too tough on the projects. Most had modest budgets to carry out their proposals yet we expected exemplary and complete needs assessments, research reviews, research studies, development efforts, implementation and dissemination plans, and readability studies to have been completed during the first or second year of the project. With the limited resources available to the projects, such thoroughness is impossible.

D. 2. a: MPSP: NSF Descriptive Information

PROJECT TITLE: Problem Solving Strategies and Applications of Mathematics in the Elementary School (MPSP)

PROGRAM: Science Curriculum Development

PROJECT DIRECTORS: Professor George Springer
Professor John F. LeBlanc

INSTITUTION: Indiana University

DEPARTMENT: Mathematics

BUDGET: Total Granted: $515,000

Dates: 4/10/74 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: The development of modular instructional materials that focus on the problem-solving abilities of upper elementary school children (Grades 4-6), and the exploration of the utility of hand-held calculators as a facilitating tool.

PROJECT SUMMARY

OBJECTIVES

Project Goals. The development of modular instructional materials that focus on the problem-solving abilities of upper elementary school children (Grades 4-6), and the exploration of the utility of hand-held calculators as a facilitating tool.

1. MPSP will identify a cluster of reasonable conjectures related to the teaching and learning of problem solving.

2. MPSP will develop instructional materials which will implement portions of the conceptual model of problem solving.

3. MPSP will develop a conceptual model of problem solving.

4. The project will develop instruments to measure some aspects of children's growth in problem solving.

5. MPSP will work with teachers to develop a model for the dissemination of the material to classrooms across the country.

6. MPSP will develop some materials designed to teach problem solving in which the hand calculator is used.

7. MPSP will investigate the possibility of developing and using real applications of mathematics.

ACTIVITY PLAN

1. Refinement of a general problem-solving model.
2. Use and refinement of a problem difficulty categorization scheme.
3. Research-inquiry based on conjectures from observations and tryout data.
4. Explore techniques for evaluating children's problem-solving performance.
5. Develop four modules and subject them to field tests.
6. Conduct a mathematical probe for investigating the use of real applications of mathematics.
7. Conduct inservice training of teachers for field trial locations.
8. Use of consultant in order to have a broader input into the project, especially where expertise outside the project is required. This includes an expanded use of the advisory board.
9. Engage in information dissemination for the project through journal articles and professional meetings.

ORGANIZATION AND MANAGEMENT PLAN

The Mathematical Problem Solving Project (MPSP) is sponsored jointly by the National Council of Teachers of Mathematics and by centers at the Mathematics Education Development Center (MEDC) at Indiana University, the University of Northern Iowa, and the Oakland Schools (Oakland County, Michigan).

While each center will contribute to all of the tasks, no one center has the resources to accomplish all of the goals. The MEDC at Indiana University is responsible for the coordination of the entire project. Additionally, the Indiana Center is responsible for the conceptualization of the problem-solving model, the overall plan for and evaluation of materials, and the research-inquiry aspects. The University of Northern Iowa Center has primary responsibility for the developing of instructional materials and pilot-testing at the Malcolm Price Laboratory School. The Oakland Schools Center has primary responsibility for the classroom trials of the materials and, in conjunction with Indiana University, for the conceptualization of the dissemination model. The National Council of Teachers of Mathematics will provide the vehicle for dissemination.

HISTORY AND RELATED PROJECTS:

The project's first year has consisted of considerable planning and exploring. They have produced drafts of three problem solving strategy modules and field-tested two of them; they have conducted several instructional probes, done observational studies, and explored problems of inservice training; they have done experimentation with the hand held calculator as a problem solving tool; and they have prepared position papers on problem solving and the conceptual model for the project.

PERSONNEL:

Statement Concerning Project Leadership

The following changes in leadership roles have been effected in order to better meet the needs of the project and of the individuals involved.

-- George Springer has served as the project director during the initial state of conceptualization and funding. He has left that position in order to take over active leadership of the mathematical probe.

-- John F. LeBlanc has been acting as project director for the preparation of this proposal and for effecting the organization of the project for next year. He will be on sabbatical leave during the 1975-76 academic year and will return as director of the project in September, 1976. While on sabbatical leave he will serve the project as consultant and advisor on a one-fourth time basis.

-- Donald R. Kerr, Jr. will now serve as director of the Indiana Center and as acting project co-director. He will share overall project administrative duties and will act as liaison with John LeBlanc.

-- David W. Wells will now supplement his duties as director of the Oakland Center with the duties of acting project co-director. In this capacity he will share in overall project administration.

-- George Immerzeel will serve as director of the University of Northern Iowa Center. He will spend one-half time on the project and will be responsible for the direction of all activities of the Northern Iowa Center. He will be responsible for joint decision-making with the directors of the other two centers in terms of policies relating to goal modifications and implementation of the project.

Advisory Board

Dr. Robert Dilworth
Mathematician
California Institute of Technology

Dr. James Gray
NCTM Representative
Texas

Dr. John Kelley
Mathematician
University of California
at Berkeley

Dr. Jeremy Kilpatrick
Mathematics Education
University of Georgia

Dr. Eugene Nichols
Mathematics Education
Florida State University

D. 2. b: MPSP (Panel 1): Project Director's Response to 10 Review Questions

The Mathematical Problem Solving Project (MPSP) (formerly, Problem Solving Strategies and Applications in the Elementary School) is a joint project of the Mathematics Education Development Center at Indiana University, the University of Northern Iowa, and the Oakland Schools (Oakland County, Michigan). The National Council of Teachers of Mathematics is a co-sponsor. The general mission of the project is focused on improving the problem-solving performance of fourth, fifth, and sixth grade children.

In order to accomplish that mission the project has agreed on the following seven goals.

1. To develop, field test and evaluate instructional materials which are designed to improve child problem-solving performance;

2. To develop evaluation instruments which measure child growth in the problem-solving process;

3. To develop a conceptual model of child problem solving which can be translated into a model for problem-solving instruction;

4. To work with teachers to develop a reasonable and effective way to disseminate the ideas and materials developed by the project;

5. To develop some materials which are designed to teach problem solving and in which the hand calculator is used;

6. To develop a focused cluster of conjectures concerning child problem solving which can be the basis for ongoing research;

7. To investigate the possibility of developing and using real applications of mathematics with 4th, 5th, and 6th graders.

The project intends to produce and disseminate instructional materials, evaluation instruments and ideas. The hope is that these will have an impact on the mainstream mathematics curriculum, materials and practices in the schools. In this sense project materials are regarded as being prototypical.

While each center will contribute to each of the goals, no one center has the resources to accomplish all of the goals. The MEDC at Indiana University is responsible for the coordination of the project.

Additionally, the Indiana Center is responsible for the conceptualization of the problem-solving model, the overall plan for and evaluation of materials, and the research-inquiry aspects. The University of Northern Iowa Center has primary responsibility for the developing of instructional materials and pilot-testing at the Malcolm Price Laboratory School. The Oakland Schools Center has primary responsibility for the classroom trials of the materials and, in conjunction with Indiana University, for the conceptualization of the dissemination model. The National Council of Teachers of Mathematics monitors the realistic involvement of children and teachers in the project and will provide the vehicle for dissemination.

The background materials which follow are organized around the first 9 of the 10 questions posed to the review panel by the National Science Foundation.

Question 1: Is there a genuine need for these instructional materials?

Problem solving has long been recognized by educators and parents alike as an important goal of the elementary school mathematics curriculum. Indeed, every elementary school mathematics textbook is full of problems. However, the problems which appear in the mainstream text material are mostly designed to develop skill with one of the basic arithmetic operations. They do not promote the development of general skill and confidence with mathematical problem solving.

The existence of a need is important, but the timeliness of that need is equally important. Many good ideas and worthwhile projects have died or withered simply because there were more pressing demands on the part of school personnel during the project's lifetime. A project on mathematical problem solving is most timely. High among the recommendations of the conferees at the Snowmass Conference (sponsored by NSF in June 1973) and the Basic Mathematical Skills Conference (sponsored by the National Institute of Education at Euclid, Ohio in October 1975) was that an effort be made to improve the problem-solving performance of students. Further, some other elements of the school curriculum, such as science and social studies, are already emphasizing the problem-solving approach. The schools are ready to cooperate in an effort related to mathematical problem solving. For instance, one of the principals in Oakland County was contacted to see if he would recommend an individual for the in-service program being conducted at the Oakland Schools Center. (Such school administrators and teachers are besieged on every side by individuals seeking to use the schools to promote a new program of some type. As a consequence, both administrators and teachers must necessarily be hesitant, if not defensive, about becoming involved in new projects.) This administrator assumed the appropriate posture of reluctance until he heard it was a mathematical problem solving project. Then his reaction was one of total support, indicating that of all the things in the mathematics curriculum, the teaching of problem solving clearly needed such an effort.

A full day of workshop activities was sponsored by the MPSP staff on Wednesday, April 23, 1975 at the annual NCTM meeting in Denver. In the evaluation of the workshop the participants voiced unrestrained enthusiasm for such an effort in problem solving. (Appendix R of March 1975 proposal)

The interest in problem solving can also be attested to by the number of workshops given over to problem solving in the regional name-of-site meetings of the National Council of Teachers of Mathematics as well as in meetings of state and local mathematics associations. Teachers have found that the problem-solving approach in both science and social studies has considerable merit. They also realize that problem solving in mathematics is important, but their previous training has not prepared them adequately to develop children's abilities and performance as they would like. A number of leading mathematics educators have independently turned their efforts toward studying ways of improving the problem-solving performances of teachers and children. Consequently, the support of mathematics educators, teachers and administrators, which is the key to the success of any project today, is present for the Mathematical Problem Solving Project.

This general interest in mathematical problem solving suggests a need for tested materials and a scheme for dissemination. There are other closely related needs. There is a need for a conceptual model for child problem solving which can be translated into an instructional model so that educators, children and the public can understand the problem-solving process and its goals for instruction. Such understanding is very important to the success of any innovation in the schools.

There are currently no evaluation instruments available which can evaluate child problem-solving processes and identify strengths and weaknesses. In order for developers, teachers, administrators, and the public to be able to make decisions concerning problem-solving instruction, such instruments are needed. Consequently, the project is developing methods of evaluating the problem-solving process, both to aid internal evaluation and to aid educational decision-making concerning problem-solving instruction.

There is a scattered research literature concerning child problem solving. Much of it consists of unrelated doctoral studies. There is a need to provide leadership and focus to research in problem solving. To this end the project is generating a focused set of conjectures concerning child problem solving. This list is being generated directly out of work with children and will be made available to the education community.

There has been a long-standing concern over the lack of problems which have real-world relevance, involve real mathematics and yet which are appropriate to elementary school children. The project is investigating the potential for such problems.

The advent of the hand calculator provides a useful tool in solving certain kinds of problems. Since more and more teachers are looking for meaningful ways to integrate hand calculators into their instruction the project is investigating ways to use the hand calculator to enhance problem solving.

Question 2: Is there a market for the instructional materials?

The MPSP aim is not to create a new curriculum. Instead the project is trying to provide leadership in the form of materials and ideas toward more effective instruction in a well-established part of the curriculum. Many materials contain problems, but instruction in problem solving has not proved effective. Moreover, there do not exist appropriate materials to teach the mathematical problem-solving process to children.

Teachers are calling for materials which will help them teach problem solving. Teachers are also asking for help in finding meaningful uses for the hand calculator. Even at this early stage in the project's life, commercial publishers have approached the project directors about the possibilities of publishing materials which are developed.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The project is based on the assumption that problem solving is an important and valued process. The process is described by the stages in the following child-phrased version of the classical problem-solving model of George Polya.

-- Getting to know the problem

-- Deciding what to do

-- Doing it

-- Thinking about what you have done.

The project is developing materials that will better equip a child to deal with each of these stages.

Two approaches are being used. A module like "Introducing Estimation" is designed to develop skill with estimation which is a process which can be a useful part of many problem-solving strategies. The broader the child's repertoire of such processes, the better a child should be able to deal with the "Deciding what to do" stage in the model. So in this case materials are developed to directly increase capability with one stage of the problem-solving model.

As a child experiences a sequence of such modules, the card decks of earlier modules will be mixed in with those of later modules so that the child will have experience with integrating and choosing from among various processes.

There is an old adage that the best way to learn how to solve problems is to solve problems. The project is testing the wisdom of this adage by developing carefully chosen sequences of problems with accompanying hints and questions which will enhance a child's experience with the problems. The hints and questions will be designed to improve a child's proficiency with each of the four stages of the above model. In addition to the two approaches to problem-solving instruction described here, others will be explored as they seem desirable.

It is worth emphasizing that the development of problem-solving evaluation instruments is needed to support the efforts of educational decision makers to evaluate instruction in problem solving as well as to support the project's developmental efforts. These decision makers need to have the means to evaluate the goals of any curriculum innovations. Means do not currently exist for evaluating problem-solving processes. Thus, the instrument development goal underscores the project mission of enhancing problem-solving instruction in the mainstream of the educational curriculum.

Question 4: Is the content of these instructional materials scientifically correct?

The materials are directed toward the widest possible elementary school audience in grades 4, 5, and 6. While their goal is to enhance instruction in the problem-solving process, the problems use a wide spectrum of appropriate elementary school mathematics skills and concepts, thus reinforcing other mathematics instruction. The scientific accuracy of the products is attested to by the qualifications of the members of the project policy board and advisory board who are listed below. The policy board provides the ongoing leadership of the project. The advisory board met for the third time on November 17 and 18, 1975. At that meeting they unanimously endorsed the scientific validity of project activities, concepts and materials to that date.

Policy Board:

George Immerzeel	--	Professor of Mathematics, Malcolm Price Lab School, University of Northern Iowa; Board of Directors, NCTM
Donald R. Kerr, Jr.	--	Associate Professor of Mathematics Education, Indiana University; Acting Project Co-Director
John F. LeBlanc	--	Professor of Mathematics Education, Indiana University; Project Director, on leave
George Springer	--	Professor of Mathematics, Associate Dean for Research, Indiana University
Maynard Thompson	--	Chairman, Mathematics Department, Indiana University
David W. Wells	--	Supervisor of Mathematics, Oakland Schools (Pontiac, Michigan); Acting Project Co-Director

Advisory Board:

Robert Dilworth	--	Professor of Mathematics, California Institute of Technology
James F. Gray	--	Vice President, University Planning, St. Mary's University; past board member, NCTM
John L. Kelley	--	Chairman, Mathematics Department, University of California at Berkeley
Jeremy Kilpatrick	--	Professor of Mathematics Education, University of Georgia
Eugene Nichols	--	Professor of Mathematics Education, Florida State University; Director of the Project for the Mathematical Development of Children

Question 5: Is the content of these instructional materials educationally sound?

This question is more difficult to deal with than the one of scientific accuracy. The materials are being developed through interaction with children. Each module, once written, is pilot tested, revised, pilot tested, and revised. During each pilot testing, observations are made, records are kept, tests are given and teachers are debriefed--all in an effort to gain every possible insight into the effectiveness of the materials and into possible improvements.

Children are different, and children do have difficulty in solving problems. Attempts have been made to provide for the differences and the difficulties.

Some children have problems with reading. The project has used formats with cartoon and picture presentations which involve few words as well as formats with a higher word density.

Many children have problems with simultaneous conditions on problems and with the use of certain strategies. These difficulties are being taken into account in problem selection. They are not, however, being avoided.

To promote student interest and involvement, problems are posed in both real-world and whimsical settings. There are preliminary indications that these efforts are successful. Children have been reluctant to leave their problem solving to go to recess. In some instances, children are carrying their problems home to their parents because of their interest--not just to get the answer.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

The proposed outcomes of the project are improved problem-solving confidence and skill of children in grades 4, 5, and 6. The project is generating ideas and prototypical materials with the expectation of enhancing problem-solving instruction in the mainstream mathematics curriculum.

There seems to be little danger of unfortunate side effects from the efforts of MPSP as long as the new emphasis on problem solving is not overdone. Many good ideas go bad because they are overdone. This is why MPSP is not proposing a total problem-solving curriculum. It is rather proposing a more effective approach to a well-established portion of the curriculum. Basic computational concepts and skills are still and will be an important part of the elementary school curriculum.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

Yes, the new materials will present some implementation problems. These problems should be no greater than with any other change in the curriculum. Teachers will have to become oriented to a new point of view toward problem solving. Last week one of the new Oakland pilot teachers made the following comment:

> "This booklet, this instructional guide, has been very valuable to me. I am not math-oriented, and I have found that in working with the kids, it helped my way of thinking; and I feel that everybody doesn't think like this. I teach computation; I have taught it for a long time and do a fair job, but it doesn't mean I can think like this. I think it has been good for me as a teacher to have had this instruction."

It is the project's feeling that with limited experience with project problems and materials such a change can be anticipated. This view is further borne out by preliminary testing (see Report of Teaching Problem Sort Tests Measuring Priorities For Problem Solving And Estimation of Child Interest).

One of the thrusts of the pilot work with the teachers in the Oakland Schools is to develop an efficient and effective procedure to orient teachers to the materials and ideas of the project. This task is made easier by the fact that the materials mandate no particular teaching format. They can be used in a self-contained classroom or with team teaching. Children can work with them individually, in small groups or as a whole class. The project is collecting data concerning the most effective formats for using the materials. This data will become part of the teacher packet which will accompany the materials.

No new, expensive materials or equipment will be required to use MPSP materials or ideas. While the materials will present an opportunity for the effective use of hand calculators, they will not require the use of hand calculators.

Question 8: Are the costs for implementing these instructional materials reasonable?

Continuing our discussion of cost--in the long haul it is anticipated that there will be no additional cost to school districts who wish to profit from MPSP development. It is hoped that MPSP ideas and materials will have had an adequate impact on standard curriculum materials to effect the desired changes. Three of the members of the MPSP policy board (Immerzeel, LeBlanc and Wells) are authors of major elementary school text series. They see this desired impact as a realistic goal. It is, of course, a goal that will only be reached after extensive evaluation of MPSP materials and ideas by the educational community. The National Council of Teachers of Mathematics has asserted its desire to be an important vehicle for this evaluation. The yearly NCTM name-of-site meetings throughout the country provide national gathering places for educational leaders at all levels.

There will be some cost to those pioneering school districts who want to take part in the initial pilot testing and evaluation of MPSP ideas and materials. This cost will largely be in the form of released teacher time and possible teacher and administrative travel expenses.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The administration of the project is being accomplished at minimal cost. The services of the six-man policy board are available at a cost of 1-1/3 FTE. This amount includes the project director and the

directors of each of the three centers--all of whom are taking an active part in development as well as administration. Uncertainties with respect to NSF funding commitments have had a negative impact on staffing and efficiency in some cases. It was, however, the general feeling at the November 17 and 18 meeting of the project policy and advisory boards that the project is functioning cohesively and effectively.

Internal evaluation is a major thrust of the project. Oakland Schools children are being tested on a pretest, posttest basis by a battery of tests--some project developed, some nationally normed. Each module trial is accompanied by formal testing and observation along with intensive teacher debriefing. Additionally, NCTM provides internal monitoring of the project's meaningful and effective involvement of children and teachers in the development.

External monitoring is provided by the MPSP advisory board and by the project manager Dr. Joseph Payne at NSF. In addition, NSF funded an external evaluation of the project during its first year. This evaluation was conducted by Dr. Francis X. Archambault (see Final Report: A Formative Evaluation of the Mathematical Problem Solving Project, May 1975). This evaluation suggested several changes in the project, particularly with respect to the administrative structure. It is important to note that most of these changes were effected and have proved to be effective.

Finally, with respect to keeping NSF informed. We have communicated with NSF in several ways, including proposals, evaluation reports, phone conversations, and NSF site visits and attendance at advisory board meetings. We have been and are open to greater communication and will make every effort to increase that communication.

D. 2. c: MPSP (Panel 1): Panel Responses to 9 Review Questions

MATHEMATICAL PROBLEM SOLVING PROJECT

This review of MPSP, the general mission of which is "to improve the problem-solving performance of fourth, fifth and sixth grade children," is based on information from the following sources:

1. the original project proposal,
2. the continuation proposal,
3. project materials, papers and information supplied by the project directors,
4. the report of an external evaluator,
5. discussion with the project manager.

The panel obtained a general impression which pervades and affects responses to all the questions to which it addressed itself. We wish to emphasize that we find this project in a very early stage of development, a stage that is still largely exploration. Throughout even the most recent materials, one has the impression of promise and intention and a continuing search for clear-cut directions. The concrete products and results and tangible evidence of progress toward stated goals are limited. The project is in its second year. We believe it is valid to raise the question of what is a reasonable length of time to allot to initial exploratory phases.

Question 1: Is there a genuine need for these instructional materials?

The need for these materials as assessed by the MPSP tends to be based on conclusions reached at conferences held the last few years in such places as Snowmass (Colorado) and Orono (Maine). In addition, certain assumptions are made about the need as seen by educators. As stated in the original grant proposal, "teachers and administrators alike are willing to accept a curriculum that would emphasize problem solving and applications." A further statement concludes, "the current intellectual climate is right for a move in this direction."

With regard to research, the original grant proposal states that there is "general consensus" that school mathematics programs do not develop problem-solving processes in children and that there is a need for basic research in problem-solving.

The need for this project seems to be based more on general feelings and observations than on any formalized approach to needs assessment. Organizing a conference to generate a need and making conclusions based

on impressions from a selected segment of the population might well be challenged. However, it is true that there do not seem to be many suitable materials for use by the schools that stress the strategies of problem solving for elementary school children.

Question 2: Is there a market for these instructional materials?

The need for good instructional materials focused on mathematical problem solving appears to be great. Except for some attention in textbooks, the techniques of problem solving receive little attention.

Whether or not there is "room" for inclusion of the MPSP materials in the curriculum depends entirely on the priorities of the school staff. How the classroom teacher values the proposed instructional method or material is of prime importance. If the program is felt to be significant to the educational growth of children, teachers will most likely find "room" for it.

As far as dissemination is concerned, there does not seem to be any specific plan other than to use the support and services of the National Council of Teachers of Mathematics. However, various authors and staff members have discussed problem solving ideas and plans at a number of conferences and meetings held across the country.

One must realize that many teachers and other educators will be "missed" if plans for dissemination are restricted to professional organizations and casual meetings. A good market means not only a good product, but also high visibility to insure wide dissemination.

If the final product follows the intent of the project and meets the goals as stated in the original and continuing grant proposals, there is strong reason to believe that many schools would be anxious to use the materials. There seems to be little disagreement over the fact that there is a great need for this type of material at the elementary school level.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The general mission of the MPSP is to improve problem solving performance of fourth, fifth and sixth grade children. Background material for the project states seven goals involving the development, testing, evaluation and dissemination of materials; the development of conjectures, a conceptual model and evaluation instruments related to childrens' growth in problem-solving ability; and the investigation of the possibility of developing and using real applications of mathematics.

As overall goals, the intent is clear enough. But there are two major difficulties in assessing the clarity of purpose as reflected in project outcomes to date and the supporting rationale for existing materials.

First, the expression of goals together with the limited quantity of completed materials indicates a very early developmental stage: exploration, investigation of possibilities, conjecture and search. Throughout the proposal for continuation there is more a sense of promise and intention than evidence of progress. One dominant impression is that the project is still searching for clear-cut directions. A positive aspect of this impression is what seems to be a recognition of the need for careful research. On the other hand, the range of possible alternatives in attacking a mission of this magnitude is enormous and the need for a limited focus and systematic selection of specific sub-goals is acute.

A related issue is that of the sequence of accomplishing the stated goals. For example, it would seem that the development of a "cluster of conjectures" concerning childrens' problem solving might have preceded the development of a conceptual model of problem solving and might reasonably have been expected as an outcome of the first year of the project. Yet the two appear to be parallel goals in plans for the immediate future.

In general, we feel that the project should spell out more clearly the relationship among components. The seven goals are surely not independent. What is their interrelationship? For example, there is needed a more detailed description of how a conceptual model might generate instructional materials. In fact, we find in general a lack of specificity in indications of what criteria are used to select content and problems.

A second major difficulty in assessing the clarity of purpose centers around the failure to define more clearly what is meant by "problem solving." It is not clear how "success" or "growth" in problem solving ability will be recognized or measured without a more specific definition of the term "problem solving." Again, one assumes that definition and specification of particular strategies or steps in problem solving will be forthcoming in the conceptual model to be developed. In the meantime, a clear rationale for the particular selection of tasks and problems represented in the existing materials is impossible to ascertain.

A more detailed rationale for the selection of tasks and activities from the range of possible alternatives is needed. What criteria were used in the choice of problems in present materials? A firmer conceptual foundation for the generation of the specific strategies encouraged in the problems would make development of materials appear less random. For example, why estimation? Where does it fit in the overall picture of strategies or approaches? What is the relationship between guessing and estimation and exact answers? Does the project assume that there is one best strategy for all children in the solution of a given problem? If not, do the stated purposes provide for multiple approaches, optimal

approaches, variations in preference and learning style? Do concerns such as transfer to new and "real-life" situations (always assumed in problem solving instruction), entail any special set of criteria for problem selection?

Also related to the question of clear rationale is the extent to which MPSP builds upon previous research. In the background material there is the suggestion that research literature bearing upon the project's general mission is scarce or nearly nonexistent. Yet there is a long history of psychological literature on problem solving. A legitimate question, unanswered by project materials, is the extent to which this literature is or is not appropriate to the rationale for project development. Has it been systematically explored? For example, how do project materials take into account some well researched barriers to effective problem solving, such as functional fixedness, psychological set, etc.?

In general, we find little indication that project developers have immersed themselves in the research literature that might bear in some respect upon their mission.

One of the impressive positive features of the project is its study of small group or team problem solving. The stated goals, purposes and rationale might well clarify in greater detail the role, strategies and anticipated outcomes specific to the context, in contrast to individual approaches.

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>

In a narrow and simplistic sense, one could interpret this question as asking: Is the mathematics used or developed accurate and free from error? The direct answer is "yes." But in a broader sense, the selection of content for problems, for modules, etc., inevitably involves assumptions, beliefs, predictions about the direction of mathematical development and applications in general and depends upon broad, long-term goals for mathematics education. In the first sense, the answer the project gives, i.e., the credentials of Advisory and Policy Boards speak for the validity of content, might be satisfactory. But such a response is certainly inadequate from the standpoint of the broader interpretation of the question. If "correct" can be interpreted as meaning more than narrow "accuracy," then selection of content and exclusion of other content is value-laden and there is by no means unanimity of opinion in professional mathematics or mathematics education as to selection or emphasis on particular content. Thus this question may need to be addressed more seriously by project leaders as the rationale for particular content inclusion.

For example, it may be that what doesn't appear in materials is as important to consider as what does. When mathematics is seen as an application for "real-life" problems or as evolving out of problem situations at this level, there are particular areas of mathematics that receive considerable treatment (e.g. measurement, graphing, statistics, etc.) while others may rarely be utilized. Furthermore, there is the danger that the mathematics appears fragmentary and loses a sense of structure and systematization and unity. When materials are designed as supplementary, they need not carry the full burden of systematic content development but it is probably legitimate to ask materials developers to address the question of what portion of the regular curriculum objectives is being met and in what specific ways do project materials integrate with, complement or assume as pre-requisite the existing mathematics programs of the schools. Surely it is inefficient at best to carry on project activities as completely independent of and in addition to regular mathematics curricula. The relationship needs to be clarified as a guide to schools which want to use project materials and ideas.

While materials already developed are mathematically accurate, we wish to stress a continuing need for monitoring of all printed materials by an expert in the subject matter. We note that two members of the staff at the Indiana site will be performing this function. However, a project cannot completely monitor, in terms of content accuracy, what actually happens day-to-day in classrooms. The role of the teacher and the level of the teacher's understanding of the subject are especially significant in programs that are flexible and encourage creative approaches to solving problems. It would be useful if all projects of this type provided their considered opinions of the educational background that their programs assume or require of teachers. That is, we believe that curriculum projects can provide helpful guidance to teacher education at pre-service as well as in-service levels.

Question 5: Is the content of these instructional materials educationally sound?

Some issues of educational soundness will be dealt with under a later question on implementation. But there are few absolute criteria available to judge educational soundness. Obviously it is a very complex matter. What is reasonable to expect is that a project show evidence it has recognized issues of educational soundness and demonstrate it has seriously and systematically come to grips with those issues.

Examples of positive educational direction taken by MPSP are the study of group problem solving and the investigation of the rise of calculators. Evidence in the proposal and materials indicates sound approaches to these investigations. But partially because of the importance and currency of these educational issues they are controversial and thus may invite some

adverse reaction. We are already aware of considerable, well-publicized reaction to the role of calculators in the schools. To what extent are project leaders prepared to provide public information and education concerning the role of calculators? To what extent should such projects be expected to justify calculator use and answer legitimate concerns about possible negative effects of calculator use such as those voiced by a chapter of the NAACP?

We are concerned by the seemingly exclusive reliance on paper-and-pencil methods in the instructional materials. Project information should speak to the possible role of manipulative materials and the relationship of such materials to their modules and card decks. We also question the quality of the card deck materials and find many of the problems unimaginative. Are these really superior to a set of problems that might be developed by individual school districts on a local basis? Most significantly, we find it difficult to discern a consistent set of criteria for selecting problems or a clear relationship to differing cognitive levels.

Another concern is the readability of project materials. Project informational material does speak to this issue but we question whether the solutions presented are adequate. It is insufficient to test by having a few children try to read materials when more sophisticated readability tests are available. Furthermore, the statement that because of reading problems, materials are presented in cartoon format is facile and superficial. Certainly reading is no easier when the words are presented in cartoon "balloons" as issuing from the mouths of cartoon characters than when presented in traditional form. In the Estimation booklet, for example, the pictures do not carry any of the burden of communication at all and the crowding of printed words into cartoon "balloons" makes them more difficult to read. The reading level of materials and individual differences in reading ability are issues of significant concern in assessing educational soundness and deserve more serious attention from project developers than project information indicates. It is no doubt possible to use cartoons effectively so that pictures actually communicate. Present materials give little indication of this.

Another possible reason for use of cartoons is one of motivation. Have project developers found greater interest in cartoon formats than standard problem presentation formats? Furthermore, the pros and cons of cartoon use should be considered in depth. Entertainment value is, of course, not the overriding factor in instructional choice.

The question of motivation and interest are pertinent to the issue of educational soundness. Project background materials appear to make the assumption that problems are interesting to children of this age if they are either real-world or whimsical. This assumption is a little too pat. Has there been or is there planned an investigation of what constitute

interesting problems and what is meant by "real-world"? What is "real" and "familiar" to children? And to which children? Surely there are individual, regional and other differences.

Another question which should be considered to a degree greater than that indicated is that of individual differences in learning style, cognitive preferences, intellectual ability, etc. To what extent do project materials take into account and adapt to varying cognitive levels? What are the project's detailed plans for relating the problems, materials and strategies to these complex issues of individual variation?

Finally, there are instances in which we question the interpretation of particular strategies. While we concur that estimation is an important skill and useful strategy, we believe the basic notion is distorted when children are told, after making a "guess," that there is a "correct guess"! (See card deck for estimation module.) Ideas of guessing, estimating and giving "correct" or acceptable answers are muddled in this module.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

A brief answer to this question is necessitated at this early stage of development. The proposed outcomes and goals are surely desirable ones. Few could quarrel with the desirability of increasing childrens' capabilities in solving problems, however limited the domain. The impact of the materials is almost impossible to predict until much more material is produced. Effects on school programs and other curricular areas will be considered under the question on implementation.

However, there is a need for closer attention to the problem content with respect to bias and stereotypes. Someone with awareness of subtle stereotyping should monitor problem content. For example, the problem relating to the woman who conceals from her husband the price she pays for a dress is one which reinforces a sexist stereotype. (See module on Organized Lists.)

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

The strategy for implementation and diffusion of any innovation is at best a difficult undertaking but a most important one. It must be given major attention and consideration. There must be dedicated leadership and an enthusiastic staff to realize the goal of assimulation within the accepted school curriculum. Concerning the MPSP, teachers must both feel a real need and have the expertise to deal with the program. This is true of any proposed curriculum project. As this is largely a supplementary program, it must be viewed by teachers as a most effective if not necessary addition to the curriculum. As we know,

supplementary programs are often overshadowed by programs considered more basic. A point could be made that the MPS Project might be better described as one to complement an existing program rather than to supplement.

It becomes apparent that staff in-service programs must be established if this project is to become a reality and is to attain any degree of success. It could well be said that in-service education (staff development) may be more important than the development of new materials.

Several thrusts are necessary to help insure that teachers have the background, knowledge, and skills necessary to implement the MPSP in the classroom. That teachers have similar backgrounds is an assumption often made in devising in-service programs. The fact that this assumption is invalid makes it important to structure alternatives and options within the staff development program.

Certainly research on child problem-solving and general problem-solving strategies are important components of any in-service program. There must be a general orientation to mathematical problem solving--an area that may be somewhat neglected and therefore unfamiliar to many teachers. This emphasis should be coupled with a review of how children learn, grow and develop. Mathematics must be appropriate for learners at various developmental stages and reflect the order in which some mathematical topics must be learned. Our knowledge of how children learn is constantly developing and must therefore influence the decisions of those who develop curriculum.

To make it realistic for staff, it is recommended that in-service techniques be employed that stress simulated problem-solving and role-playing activities.

Since the inclusion of calculators is a possible addition to the MPSP, attention should be given to their use as a classroom instructional device.

The MPSP does not seem to pose any special problems for existing organizational structure within the schools. Actually, the plan would seem to fit any building or classroom organization. Its inherent flexibility would allow for implementation in schools ranging from the traditional to the open.

In the use of activity cards, it would be well to identify the various materials called for and to have them ready for use. In fact, a teacher reference list identifying these materials would be a valuable addition to the program allowing for easier and more efficient organization.

If the program is to include the use of calculators, budgetary requirements must be faced. It goes without saying that calculators must be available to all children capable of using them in the program.

While the MPSP materials are supplementary to a basic math program and, therefore, not <u>necessarily</u> needed by all students, they must be suitable and appropriate for all who find them rewarding in terms of motivation and growth. For instance, it would be appropriate for some schools and for some children to have bilingual materials. Activities must also comfortably fit the wide range of abilities and interests exhibited in elementary school children.

While activities may be appropriate to a range of abilities and interests, they may not necessarily be appropriate to the intent of the project and the welfare of the learner. Implementation of activities that fall short of stated goals may result in a waste of time and talent. If a primary goal is to add ingredients which will develop the students' ability to use their mathematics with confidence in situations they are likely to encounter in their lives, there must be a far greater stress on implementing a program which stresses "hands on" activities. The MPSP learning problems seem at least at this point to be dominated by "pencil and paper exercises." In addition, the content and learning activities must be useful to the child as he or she develops and must also extend accurate interpretations of the world. Again, there is some question whether these goals have been met in the present MPSP instructional materials.

Implementation can be slowed or completely blocked by a public unwilling to accept change. Can the needs of students be adequately met unless there is some enthusiasm or at least an acceptance of new programs by parents and the general public? We must find a way to modernize our programs in concert with the public. This means not only solicited and unsolicited reaction to programs but also direct public involvement in proposed and ongoing educational programs. Although stated as an important goal this point seems to have been forgotten in the past and future plans of MPSP.

Programs can hardly be implemented if the reading and language needs of the learner are not met. Any program of instruction largely depending on the written word must take into account a very wide range of reading proficiency. It would appear that this issue needs further emphasis as it pertains to the activity cards used in the MPSP.

One issue that needs to be raised concerns strategies for local implementation. This can be a problem of the greatest significance. The Panel is of the opinion that the <u>local</u> plan for dissemination and implementation of curriculum should be examined carefully. A well-defined structure for change and innovation on a local school level would seem to be most important. The Panel feels strongly that unless there is a <u>team</u> approach

to curriculum revision, little will be accomplished in terms of needed change. Commitments and support must be diverse and continuous and must not be allowed to center on one agency or one person. An enthusiastic team of teachers, principal, children and parents help to insure that change will be both implemented and disseminated. This is a real challenge and one that calls for the very best efforts by any who contemplate change or consider themselves agents of change.

Question 8: Are the costs for implementing these instructional materials reasonable?

Costs for the implementation of this program on a school district basis would seem reasonable. However, it is assumed that the durability of learning materials will improve to the point where replacement will not be a prime consideration. It is feared that the quality of present materials will not withstand the stress of an average classroom of elementary school children and, consequently, replacement needs would become an important factor.

In addition to material needs, funding for in-service education is a matter that must be considered in overall cost. This is so important that most careful consideration should be given to providing sufficient funding for quality staff development programs.

Certainly it must be recognized that there are other ways in which a school district might spend equal funds to accomplish the purpose of upgrading the mathematics program. While it is not our purpose to investigate possible options, it should be pointed out that programs that start at a district level involving the enthusiastic support of many are the most likely to stand a chance for success as far as assimilation and implementation are concerned. There is much to say for a model which will help schools to develop curriculum at a local level with local educators playing an active role in the initiation, development and evaluation of curriculum projects.

Question 9: Is the management/organizational plan adequate for producing these instructional materials?

The complexity of the project in attaining the identified goals as well as the advantages and disadvantages of the multi-site plan to accomplish this undertaking is recognized. There is documentation of interaction and communication between the site personnel, including coordinated efforts on the review of materials developed at each site. The extent of this communication is unclear. Also, the question is raised, "What was the response of the project staff to the recommendations made by the external evaluation?" It seems that a concerted effort must be made to improve continually the communications within and between sites for quality and efficient development and evaluations of the instructional materials and the changes effected.

On the basis of the information provided to the Review Panel, we are apprehensive about the lack of clarity of the conceptual models and how these models are being used to direct the activities developed, the instructional approaches followed in the implementation of these activities and, in turn, the assessment of change in student behaviors for improved problem solving capabilities. The management plan, dealing with the project objectives simultaneously, raises concerns with respect to unification of development of materials, try-out of them, revisions, the instruments for evaluation, and the conditions under which measurements of change are to be made. Furthermore, the management-organization plan should be carefully reviewed in an effort to ascertain whether or not this project has selected the most desirable of the possible alternatives to accomplish its objectives, whether it is desirable to continue operations from three sites and whether or not a more systematic approach to the sequence of activities in accomplishing its proposed purpose is more desirable.

The Panel recommends that consideration be given to increased membership of the Advisory Board as well as to a more active role of participation by members of the Board. Although members of the Advisory Board represent expertise in areas of the project efforts, a person or persons with specific expertise in learning and teaching mathematics at the upper elementary school level and/or in the psychology of learning would be expected to enhance the contributions of the Advisory Board.

It is the understanding of the Review Panel that the efforts of the National Council of Teachers of Mathematics to initiate a project in problem solving culminated in the co-sponsoring of the initial proposal with Indiana University who had similar interests. The continuing role of the National Council of Teachers of Mathematics in this project is not explicit nor has the Panel found documented commitment. Clarification needs to be made on these matters.

D. 2. d: MPSP (Panel 1): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

NSF Staff Note: Panel 1 submitted a general response of the whole panel which applies equally to all five curricula reviewed by Panel 1. In addition, one panelist submitted an individual comment which applies equally to all five curricula reviewed by Panel 1, and one panelist submitted individual comments on each curriculum.

Panel 1's common response:

In addition to expressing its opinions on individual projects, the panel wishes to express itself on curriculum projects in general. The following paragraphs describe issues that the panel feels strongly about and which we believe the NSF must take seriously in their deliberations regarding the Foundation's support of curriculum development.

Long Range Implementation

The Review Panel expresses a concern with respect to all projects in the area of long range implementation plans. Projects must make provisions for long term teacher education programs with local school districts to insure proper implementation and use. Lack of adequate commitment to this issue in the past has led to misuse, misconception and a questioning of the actual value of the project itself.

A project must make provision in its design to work with local school districts in providing a systematic plan for implementation which is mutually acceptable and cost effective for both the project and the local school.

Projects must also consider the implications of teacher education programs at the university level if the project is someday to become widely used. This must be considered by projects if the teaching strategy employed is divergent from current practices and in light of the fact that the local schools will be the recipients of teacher education programs.

Parent Involvement

The school and the home have one common concern from the beginning--the child. Therefore, education of children must be a teamwork

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effort. The child cannot be the victim of a tug of war over who knows best for the child, because the res lt is frustration for teacher, parent and child. Instead of the three R's, the three C's need to be implemented. There must be communication, compromise and genuine concern between home and school.

Parents should and must be included from the beginning when curriculum materials are developed. However, care must be taken to remember that parents are for the most part lay people and should not be overwhelmed with educational jargon. Their contributions are important not only because of their concern and knowledge about children, but also because they are free of any constraints imposed by involvement in the professional educational establishment.

Child Development

It is generally agreed that the most effective curriculum materials are those which are adapted to the developmental level of the children for whom they are constructed. This means that in any group attempting to construct new curricula, there should be one or more persons who are solidly grounded in the field of child development. This was not always the case in the projects reviewed by the panel. As a consequence avoidable errors in curriculum construction were made and potential insights into the worth of particular materials were lost or not fully appreciated. NSF should seek to insure that child development skills and knowledge are represented in government-supported curriculum projects.

Use of Supplementary Curriculum Materials

Each of the curriculum projects evaluated by Panel 1 is considered a "supplementary" program in the sense that they do not intend to replace or supplant established subjects or their entire arrays of curricular goals. For example, none is the mathematics program or the science program.

However, when these programs are truly integrated with or complement established subject and skills areas, someone must confront the difficult problems of interrelating the components. Projects, we believe, have some responsibilities in seriously grappling with these issues and providing guidance to schools that goes beyond the narrow role of project implementation.

Development of process goals in problem solving behavior is a very important, and long neglected, objective of evaluation. However, other important objectives remain and should not be overshadowed. There

are certain emphases in, say, mathematical skills and concepts that inevitably result when the major focus is on the application of the subject to "real" problems. The important role of mathematics and scientific disciplines as a useful tool is stressed. The danger lies in the possible neglect of other aspects of the discipline. Those responsible for the curriculum should be certain that the unitary, systematic, structural nature of the subjects is not lost in the process. The knowledge and views obtained by the child should not be of disciplines as fragmentary bits and pieces, however useful.

We merely state here that supplementary projects should not avoid responsibility for this difficult problem but should seriously award it continuous attention.

The Role of the Federal Government in Curriculum Development

The Federal Government clearly plays a leadership role in curriculum development, but the nature of that leadership needs to be carefully considered. For example, is it better to use federal resources to build programs at a regional and national level and then attempt to disseminate them to local school districts? Or would there be a better return by encouraging local school districts to improve their own programs through staff development and local curriculum projects that meet the needs of the community?

Teacher Involvement

The extent to which teachers are involved in the projects reviewed by the Panel varies greatly. Since elementary school teachers are the key to the effective outcomes of all projects for improved learning of children, the Panel strongly recommends that teacher involvement is necessary in all stages of planning, development, and implementation of the project efforts.

Representation of Women and Minorities

Project leadership and staff should be representative of a cross section of the educational community. Involvement of minority group members and women in the planning, development, implementation and governance or advisory tasks has been missing in some of these projects. Key personnel in at least two of the projects reviewed were almost exclusively white males.

In addition, it was also apparent that some key personnel were involved in more than one project. This overinvolvement of project staff not only limits the range of talents, abilities and insights available but also limits leadership of curriculum development to a small group. The panel believes that NSF should encourage project directors to have a broader representation of minorities, women and key professionals on curriculum projects than is apparent in these projects.

Panelist: Dr. James R. Okey

My only concern with our review is that we may have been too tough on the projects. Most had modest budgets to carry out their proposals yet we expected exemplary and complete needs assessments, research reviews, research studies, development efforts, implementation and dissemination plans, and readability studies to have been completed during the first or second year of the project. With the limited resources available to the projects, such thoroughness is impossible.

D. 3. a: PMDC: NSF Descriptive Information

PROJECT TITLE: Project for the Mathematical Development of Children (PMDC)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Dr. Eugene D. Nichols

INSTITUTION: Florida State University

DEPARTMENT: Mathematics Education

BUDGET: Total Granted: $815,800

Dates: 6/1/74 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: To gain new insights into the ways in which young children (Grades K-3) acquire mathematical concepts and skills. It is intended that these insights serve as a potential basis for future curriculum and instructional development.

PROJECT SUMMARY

OBJECTIVES

Project Goals. The main emphasis of the Project is on the investigation of the ways in which children succeed or fail to learn mathematical concepts and skills. More specifically, the Project has the following nine objectives.

1. To develop interview techniques with individual children, which will result in insights into children's modes and patterns of thinking.

2. To work with teachers to develop techniques for evaluating individual children's understandings in mathematics, mainly through observations and interviews.

3. To develop and test techniques for reliably assessing the understandings and skills children have when entering the first and second grades.

4. To study the feasibility of teaching children some selected concepts and skills which are not ordinarily taught in standard curricula at this age level.

5. To study the feasibility of teaching the usual first and second grade level concepts and skills, but employing different approaches with the aim of achieving greater success.

6. To develop modules, including various aids, in pursuit of the above five objectives.

7. To identify those practices with which teachers succeed; to capture, refine and extend these practices to other teachers.

8. To explore ways in which teachers can successfully learn to incorporate into their daily practice the materials produced and findings obtained in meeting objectives one through seven.

9. To develop techniques and procedures for evaluating all activities pursued in meeting objectives one through eight.

ACTIVITY PLAN:

The PMDC staff have adopted a general plan of using teaching experiments and interview techniques to explore a selected list of conjectures. The FSU site will have four principal investigators, each with full time responsibility to the project, plus the support staff and facilities for the headquarters of PMDC. The studies to be conducted deal with conjectures in four areas:

1. Relation concepts, with particular emphasis on equality

2. Numeration--Symbolization

3. Place value

4. Basic operations, with emphasis on addition and subtraction

These are the same areas of investigation as the studies at the Georgia site, but the plans are for coordinated and complementary studies, rather than duplication. The Georgia site will have four Principal Investigators each devoting one-third time to PMDC.

ORGANIZATION AND MANAGEMENT:

General policy oversight for PMDC is vested in an Advisory Board the members of which are listed under personnel. The project operates at two sites: Florida State University and the University of Georgia. The Director, Dr. Eugene Nichols of Florida State University, has overall management responsibility for the project. Dr. Tom Cooney of the University of Georgia serves as Coordinator at that site and Dr. Merlyn Behr serves as coordinator for investigations at the Tallahassee site.

HISTORY AND RELATED PROJECTS:

PMDC was one of four proposals supported as the result of recommendations made by the Mathematics Education Panel in January 1974.

The project has engaged in a series of studies to investigate the way children succeed or fail in learning mathematics concepts and skills. Interview techniques and exploratory teaching experiments have been used to study children's patterns and modes of thinking.

During 1974-75, the project had a subcontract of $75,000 to the University of Georgia and a subcontract of $14,800 to Ohio University for support of investigations at those institutions. In addition, work of investigators at the University of Texas was supported from funds administered at Florida State University.

Due to budgetary and other concerns, the project was consolidated into only two sites for 1975-76.

PERSONNEL:

Florida State University. Dr. Eugene D. Nichols, Director and Principal Investigator; Dr. Thomas Denmark, Associate Director and Principal Investigator; Dr. Merlyn Behr, Site Coordinator and Principal Investigator; Dr. Cynthia Clarke, Principal Investigator, and Mr. Max Gerling, Technical Assistant.

University of Georgia. Dr. Thomas Cooney, Coordinator of Athens Site; Dr. Larry Hatfield, Principal Investigator; Dr. William McKillip, Principal Investigator; Dr. Leslie Steffe, Principal Investigator; and Dr. L. Ray Carry, Consultant for Internal Evaluation, University of Texas.

Advisory Board: The current Advisory Board would continue in the same capacity. The Board consists of the following individuals:

Dr. Edward Begle
Stanford University

Dr. Walter Dick
Florida State University

Mr. Edgar Edwards
State Supervisor
Virginia

Dr. John LeBlanc
Indiana University

Dr. Gerald Rising
University of Buffalo

Dr. Charles Smock
University of Georgia

Dr. Stephen Willoughby
New York University

Dr. Lauren Woodby
Michigan State University

D.3.b: PMDC (Panel 1): Project Director's Response to 10 Review Questions*

INTRODUCTION

A two-day conference supported financially by the Florida State University and held in Tallahassee in September 1973 was a forerunner of the Project for the Mathematical Development of Children (PMDC). The conference was designed to make an assessment, by knowledgeable individuals, of the effect of the past curriculum efforts in mathematics education on the teaching of mathematics in the elementary grades and interpret this effect in terms of future needs. The proceedings of the conference were published and the publication is available from PMDC. For the contents and the participants of the conference see Enclosure 1 (Table of Contents - Proceedings of the Conference on the Future of Mathematical Education).

The participants in the conference, several of whom had extensive experience in curriculum development, recognized that curriculum construction in mathematics had traditionally taken the form of a five-step process:

1. Logical analysis of the subject matter to be presented,

2. Individuals possessing the needed competencies are selected,

3. Through group interaction, outlines are developed and consensus established,

4. Various individuals assume writing responsibilities for portions of the curricula,

5. Drafted material is reviewed for completeness, consistency and integrated across different authors' portions.

PMDC represents a departure from the procedure outlined above. Instead of the usual logical analysis of content and sequencing of topics, PMDC has chosen to observe and systematically study the behavior of children when exposed to mathematical ideas in an intensive clinical manner.

Following the conference, Dr. Eugene D. Nichols, Professor of Mathematics Education at Florida State University (now Director of PMDC), submitted a proposal to NSF for a project which was initially funded for a twelve-month period beginning in June 1974.

The experience of the last twenty-five years suggests that a mathematics curriculum based solely on the logical sequencing of the subject matter presents implementation difficulties for both teachers and students. What is needed is a mathematics curriculum which aims at the early grades and which pays attention to the ways in which children learn mathematics and which takes advantage of the natural ways children think about mathematics.

* NSF Staff Note: Referenced enclosures are not included with this report. Copies are available from the Project Director.

The efforts of the 1950s and 1960s were aimed at teaching children better mathematics. While this is certainly needed, one must also consider the question as to what is meaningful for children. This lies in the realm of psychology. However, psychology, including learning of the specific mathematical concepts and skills which are in the mainstream of mathematical training.

In the real world of today's elementary school classroom with not much hope for drastic changes for the better in the foreseeable future, it appears that to build a realistic, yet sound, basis for the mathematics curriculum, children's mathematical thinking needs to be studied intensively in their usual school habitat by those who know teaching, learning, mathematics, and children. The methodology employed by the the Project is that of videotaping interviews of individual children and of teaching sessions with small groups of children. An intensive study of this videotape record by individuals with a variety of specialties leads to the formulation of conjectures as to what this thinking is, what mental structures the child has developed, and how the child uses these structures when dealing with the ordinary concepts of arithmetic. A deep analysis of this videotape record further suggests some conjectures about possible sources of what the adult views as "misconceptions", about how the school environment (the teacher and/or the materials) influences the child's thinking, and about whether the teacher and/or the materials "fight" the child's natural thought processes. Understanding these processes and using this knowledge as guides for curriculum modules will lead to the development, by others, of a more effective and efficient mathematics curriculum.

In accordance with the above aims, PMDC activities are concentrated on studying intensively and directly children's thinking and learning concerning the basic mathematical skills and concepts, for the present in grades one and two. These activities and dissemination efforts fall into five categories:

1. Clinical interviews of children.

   The purpose is to understand how children think and what difficulties they encounter in learning mathematics within the ordinary classroom setting.

2. Teaching experiments and observational studies.

   The purpose is to study children's thinking under the influence of carefully controlled mathematical environments.

3. Intensive individual assessment of mathematical knowledge of entering first and second graders.

   The purpose is to gather knowledge about what children know and are able to do through intensive individual testing, which the teachers ordinarily don't do.

4. Sharing of the findings and knowledge obtained by the above, through publications, with the profession, including curriculum designers

and textbook writers.

The purpose is to contribute toward building of a more effective mathematics curriculum.

5. Participation in professional conferences which are concerned with the learning of mathematics at the early age.

The purpose is to share and discuss the knowledge gained with all who are concerned with the teaching of mathematics.

These activities and products of Project efforts are elaborated upon in the answers to the nine questions in this document. To accomplish these ends the Project has brought together a number of outstanding mathematics educators and researchers, with interest and the necessary expertise, initially placed at four universities and presently concentrated at two universities, the Florida State University and the University of Georgia.

For factual information about the Project and its organization, see Enclosure 2 (Newsletters No. 1 and No. 2). To obtain a chronological view of the activities of the Project, see Enclosure 3 ("Chronology of Main Events").

Answers to the nine questions

EXPLANATORY COMMENTS

The Project for the Mathematical Development of Children is not strictly a <u>curriculum development</u> project. It is a research/development project. Therefore, "Instructional materials" will be interpreted to mean the several categories of products of PMDC. These consist of the following:

1. Videotaped interviews of children.

The total of over 400 hours of videotapes are now in existence. They are used for several different purposes: analysis of children's thinking, training of teachers in individualized testing, and communicating with teachers and researchers about children's thinking.

2. Records of observations of children and teachers.

These are used to supplement the videotape records in analyzing children's cognitive behavior, to study teacher's techniques, and to formulate conjectures.

3. Teaching materials and manipulative aids.

These are segments of instructional materials produced for the specific purpose of testing conjectures formulated on the basis of studies and observations. They are intended to serve as a <u>prototype</u> of instructional materials, after undergoing a rigorous test in controlled experimental environments.

4. Technical reports and other publications.

These serve the purpose of communicating the ideas and results to all who deal with the mathematics curriculum, whether in designing, creating, or using it.

5. Research findings.

These focus on the children's learning of the basic mathematical concepts and skills as they are found in the ordinary mathematics curriculum. The intended eventual use of these findings is for the design of a more effective and efficient mathematics curriculum.

Question 1: <u>Is there a genuine need for these instructional materials?</u>

The participants in the September 1973 conference unanimously recognized a need for a more scientific approach to the curriculum construction than that used in the past. Better understanding of children's thinking should be part of the guidelines base for curriculum construction.

Other leaders in mathematics education and psychology have stated recently that the greatest need for the immediate future is to investigate skills and concepts. The need to ask <u>good</u> questions and to find good answers to these questions is of extreme importance as a forerunner of any large scale curriculum development in mathematics. Such investigations, carried on within the daily realities of the classroom and by individuals who know mathematics and its teaching and learning would provide a bridge between the psychology of learning of mathematics and mathematics itself.

The usual way in which textbooks are written does not provide for this kind of necessary investigation. Similarly, teacher training does not provide prospective teachers with the kind of insights into the mathematical thinking of children that PMDC has set out to obtain.

The NSF panel which reviewed the original proposal recommended strongly that the emphasis represented in PMDC is needed.

The recent results of various assessments of students' knowledge of mathematics, including the National Assessment of Educational Progress in mathematics, have established the fact that 9-, 13-, 17-year olds as well as young adults have inadequate knowledge of basic mathematics, even of the type of mathematics required for the most elementary everyday decision making of a quantitative nature. This state of affairs suggests that there is something wrong with the teaching of mathematics.

To plunge into a major development of a new curriculum in a manner similar to that of the 1950s and 1960s would not be appropriate. Another major curriculum development should be preceded by an intensive look at the children, beginning with their first year in school, with an intent to understand better how children learn mathematics and to assess what it is that is causing many otherwise capable students to fail to learn even the rudimentary aspects of mathematics.

The need for the kinds of activities described in this document is well established within the mathematics education profession. At the present time, there are no such sources of guidelines for curriculum designers. There is a lack of guidelines for teaching mathematics which would be in line with the way in which children naturally think about and learn mathematical concepts. An effective curriculum must pay attention to the ways in which children acquire mathematical concepts and skills.

To align the curriculum more closely with a child's way of thinking, one must understand how children learn mathematics. Not enough is known about that at the present time.

Question 2: Is there a market for these instructional materials?

No mathematics curriculum based on intensive investigation of children's thinking now exists. Large numbers of capable children fail to learn many basic mathematical concepts. Many children do not learn up to their potential. The teachers, the curriculum designers, and the textbook writers, are asking questions as to why so many children fail. Good answers to these questions are not available. Teachers are at a loss to know how to instruct children with different abilities and interests.

During the past and present years the presentations of Project activities to professional groups at conferences and sharing of the conjectures with various persons have clearly indicated an intense interest in the outcomes of the Project. The Project Newsletters are mailed regularly to about 1,500 professionals and the mailing list is growing continually.

The nature of the Project is such that a successful pursuit of its objectives should result in considerable influence on the nature of the mathematics curriculum. The Project has a potential to affect in very significant ways the general direction in which the mathematics education might move. One way is to make the findings of the Project known to those who train elementary school teachers through professional publications. Another way is to demonstrate that children succeed with the learning of mathematics significantly better if the curriculum is more nearly accommodated to the children's thinking.

For an example of a professional publication which interprets some of the findings of the Project for the teachers, see Enclosure 4 ("How Children View Equality Sentences," an article submitted for publication to the Arithmetic Teacher, a journal designed for elementary school teachers of mathematics, mathematics educators, and curriculum designers.

For another example of sharing of information with the profession see Enclosure 5 ("PMDC - Its Mission and Its Functions," an article published in Contemporary Education, Hall 1975). For PMDC publication procedures see Enclosure 5a.

The Project Manager at NSF has two composite videotapes which illustrate the variety of methods used to achieve the objectives of the Project. Of the nine long range objectives listed in Newsletter No. 1, objectives 1, 3, and 5 are presently receiving the major attention. They are:

1. To develop interview techniques with individual children, which will result in insights into children's modes and patterns of thinking.

3. To develop and test techniques for reliably assessing the understanding and skills children have when entering the first and second grades.

5. To study the feasibility of teaching the usual first and second grade level concepts and skills, but employing different approaches with the aim of achieving greater success.

These objectives are recognized by teachers and mathematics educators as being in the mainstream of the mathematics curriculum.

Question 3: <u>Do these instructional materials possess a clear purpose and rationale?</u>

While PMDC is not strictly a curriculum development project, prototypical instructional materials are being developed for specific purposes. One of these purposes is to test conjectures which were formed as a result of observations of children and teachers and of teaching experiments. The instructional materials are being tested in the carefully controlled teaching experiments. The NSF Project Manager has a set of all teaching materials produced so far for this purpose. The teaching experiments are designed to investigate several of the 80 conjectures formulated during the past year. Those conjectures presently under investigation are perceived to be at the heart of the learning of most basic mathematical concepts and skills, such as place value, addition, and subtraction. Enclosure 6 contains descriptions of the following teaching experiments.

1. T1 - Effects of the Multiple Embodiment and Mathematical Variability Principles on Second Graders' Learning and Understanding of Two-Digit Addition and Subtraction.

This experiment deals with the concept of place value and its role in the development of addition and subtraction skills. Five experimental groups and one control group are under an intensive study throughout the year, which includes individual interviews designed to reveal children's thinking about these basic concepts.

2. T3 - Equality, Addition and Subtraction.

Interviews of children led to a formulation of several conjectures concerned with the children's concept of equality. It is hypothesized that the limited concept of equality (as an operator), which children acquire, may stand in the way of children comprehending mathematics and may cause them to fail in arithmetic skills. In this teaching experiment, children are taught a more adequate concept of equality (as a relation). The effects of the possession of this concept on children's understanding of

and facility with mathematical operations will be investigated.

3 Readiness for Symbolization.

Several conjectures deal with the severe difficulties some children encounter when dealing with mathematical symbols. Since symbolization is at the heart of the ordinary instruction in mathematics, a number of crucial variables have been identified the understanding of which may shed a great deal of light on the difficulties some children have in learning mathematics.

4. Constructing and Learning Alternative Computational Algorithms.

A number of conjectures suggest that the unique algorithms ordinarily imposed upon the children may be at variance with the children's perceptions. Inventing of algorithms by children may provide them with the insights needed for the intelligent use of algorithms.

5. T4 - Pictures and Mathematical Sentences: A proposed Study with First Grade Children.

Some conjectures suggest that

(a) children do not see school mathematics as having much relationship to the real world, and

(b) children have problems with symbolizing the real world and picture situations.

This study is designed to answer some questions about the relationship between mathematics and the real world.

The Project Manager at NSF has a description of the following teaching experiment.

Addition, Subtraction and Numeration.

There are certain clusters of developmental and prerequisite variables which are suggested to have a strong relationship to the ability to learn addition and subtraction and to understand numeration. Answers to questions posed in this context would suggest more effective ways of sequencing mathematical instruction.

Teaching materials (e.g. lesson plans, complete instructional modules, and visual aids) are produced as the teaching experiments are planned and carried out. For a sample of teaching materials, see Enclosure 7 (a sample lesson for T1 "U2, - Lesson 2 Two-Digit Numerals--Enactive Level," and a sample lesson for T3 - "E-5-1 Introduction to Symmetrical Property"). The NSF Project Manager has a complete set of all materials.

Another product of the Project is information about the children's knowledge of mathematics at the time they enter grades one and two. The purpose of this activity is to assess and analyze what basic mathematical skills and concepts children possess when entering these grades. Approximately 200 first grade children and 160 second grade children were

tested on a one-to-one basis by means of a commercially available diagnostic test and tests produced by PMDC. A complete profile of each child is made and the information is shared with the teachers of the children. At the present time a program is being prepared for a complete computer analysis of the results. The results and the analysis will be available to the profession as a technical publication. A series of publications will be prepared for the teachers. These will provide teachers with the kind of insightful knowledge about children's skills and methods they use in solving mathematical problems that is not presently available.

For an example of the analysis made of each child, see Enclosure 8 ("Student Profile: PMDC Grade One" and attached "Answer Sheet," and "Student Profile: PMDC Grade Two" and attached "Answer Sheet"). It shows the categories of concepts and skills which are being assessed. The Answer Sheet shows not only the precise answer the child gave but also the method which the child used in arriving at the answer. Enclosure 9 ("Descriptive Statistics - Grade 1 and Grade 2; and "Summary - Selected Key Math Items") summarizes the data on performance of first and second graders.

A rich source of data, which is being made available to other researchers are videotapes of children's interviews. They reveal children's patterns of thought about the key mathematical concepts. This kind of rich insight cannot be obtained in any other way. For a partial listing of videotapes presently available and subjected to thorough analysis at both sites see Enclosure 10 ("Index of Videotape Recordings"). The NSF Project Manager has two composite videotapes which illustrate structured interviews, open-ended interviews, individualized testing, and teaching experiments.

Question 4: Is the content of these instructional materials scientifically correct?

The instructional materials produced for teaching experiments make use of currently available findings of research. A number of graduate students in mathematics education are constantly involved in reviewing all research literature that is pertinent for a given teaching experiment.

The materials are also examined by the PMDC Advisory Board members, all of whom are recognized authorities. There is an interdisciplinary representation on the Board, which includes mathematics education, mathematics, psychology, media, and evaluation. The Project has a permanent evaluator who possesses advanced training in mathematics, mathematics education, and pedagogy; he is also a recognized expert in the field of evaluation. He systematically examines all of the products as well as contributes his judgement about the soundness of the Project's activities. His advice and critical appraisal are taken into account in all of the Project's activities.

Interview techniques employed by the principal investigators make use of what is known about interviewing. It must be pointed out, however, that no overall theory of interview techniques is now in existence. The Project's experiences with interviews might make a contribution to a formulation of such a theory in the future.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

One of the aims of the Project is to find out what kind of mathematics teaching materials are "educationally sound." Certainly, the present widespread failure of students to learn basic mathematics suggests that the presently available curriculum is not "educationally sound." To gain the necessary insights, it is imperative that investigators work daily with children and teachers in the usual school habitat. This is the method employed by PMDC.

Value-laden areas are not involved in the Project materials. Since the major emphases are on discovering ways in which teaching materials can be made to correspond more closely to the children's ways of thinking, favorable reactions from teachers are anticipated and are already forthcoming.

The learning and teaching of mathematics are very complex. Every attempt is made to identify all pertinent facts and account for them in the reporting of results of teaching experiments. The evidence obtained through the teaching experiments will be reported in an objective manner, stating both the strengths and the weaknesses of the particular approach to teaching mathematics.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

One of the projected products of the Project will be a set of guidelines and sample instructional materials developed in accordance with the research findings. It is anticipated that these will have a profound impact on authors of professional books and textbooks for children. This should eventually lead to a better curriculum for all children. It is the intent that all who are involved in producing mathematics materials for children benefit by the findings and prototype materials produced by the Project. These will be in the public domain.

Project goals will not be impacted by having or not having any findings related to sex, racial, ethnic, or religious factors. Methodological workings of PMDC do not involve the above variables. The Project carries on its activities in a variety of schools, with a spectrum of capabilities.

It is felt that the major thrust of the Project is of such crucial importance to the teaching of mathematics that there should be a provision at the national level for the permanent existence of a group like PMDC. This group would continue to be concerned with intensive clinical studies of children's thinking in the context of the usual school instruction in mathematics. The concern should be with the learning of concepts and skills which are clearly in the mainstream and not with the fancy and esoteric parts of mathematics.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

It is not within the objectives of PMDC to produce a complete set of teaching materials for grades 1 and 2. Rather it is to produce specific segments of materials to respond to specific problems. Then these exemplars with their rationale will be available to writers of textbooks where their effect will be felt. This two-step effect has a potential of reaching more students than would isolated publications of full textual materials that would not be as broadly distributed.

The above is also true of the materials that would apply to the teacher training programs. In this connection, videotapes will also make a contribution.

The above intent for the use of materials does not involve the usual implementation problems associated with exporting a complete curriculum.

Since the Project is testing several alternative approaches to the teaching of mathematics, only those that have been demonstrated to be the most effective would be recommended to the teachers. The basic assumption under which the Project is operating is that, given a better approach which more nearly fits the children's ways of thinking, more children will succeed with learning mathematics effectively.

Question 8: Are the costs of implementing these instructional materials reasonable?

There are no plans to produce complete instructional materials that would compete with the commercially produced texts. The prototype modules are of the kind that are in line with the usually expected costs of teaching materials.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

From the listing of individuals who participated in the 1973 conference, it is clear that individuals with pertinent specialities had a substantial input into the original organizational plan. Now the Advisory Board has a substantial input into the current activities of the Project. There is also involvement of various consultants from different specialties such as reading, psycholinguistics, interview techniques, etc.

The Project was subjected to a very thorough outside evaluation during 1974-75 with Dr. Francis Archambault of Boston University serving as director of the evaluation. In addition, the Project has a regular inside evaluator, Dr. Ray Carry of the University of Texas. Dr. Carry participates in all the staff and Advisory Board meetings and reacts to all phases of the Project's activities. The Project has a Director, Associate Director, and a Coordinator at each site (Florida State University and University of Georgia). Each of these individuals is a principal investigator carrying on major research and teaching experiment activities. They work as team members in teaching, producing materials, interviewing, etc. No one individual commits all of his/her time to the administration of the Project.

The Director routinely sends to the NSF Project Manager copies of all correspondence and materials. Thus, the Project Manager is fully informed of all ongoing activities of the Project. He is also invited to attend the meetings of the Advisory Board and staff.

D. 3. c: PMDC (Panel 1): Panel Responses to 9 Review Questions

This project seeks insights into the ways in which children (grades 1 and 2) acquire mathematical concepts and skills. The major thrust of the project is to formulate, on the basis of their investigation findings, "a more thorough and reliable basis" for mathematics curricula.

The Review Panel has modified the questions proposed by the National Science Foundation for the evaluation of this project. On the basis of an examination of project documents available to us, and telephone conversations with a project staff member at each site, the Panel submits the following report.

Question 1: Is there a genuine need for this investigation?

The needs being addressed in this investigation of the ways in which children succeed or fail to learn mathematical concepts and skills grew out of a conference of mathematics educators held at Florida State University in 1973. There appears to have been no systematic needs assessment as such, nor do the materials available to the Panel indicate that the literature had been searched to document needs noted by others. Although no documentation of needs was provided by the project, the Panel agrees that there is a need for a careful, thorough analysis of (a) how children think about mathematics and (b) effective teaching strategies.

Furthermore, it should be noted that this project has the potential of affecting all children and teachers in primary schools. Because of this potential, it is especially important that all phases of this project be subjected to careful scrutiny and reassessment in order that it meet its goals.

Question 2: Would the mathematics education community use the results of the investigation?

If the project does generate the results promised by the goals, then there exists an audience which could use the results. Primary level teachers are interested in considering alternative instructional strategies and techniques which have proven effective. Textbook authors and publishers, continually searching for "new" approaches, would also consider them. However, care must be taken as project results are reported that they are presented in a form which makes the ideas understandable. The manner of presentation has already led to some questioning of the project by teachers who have attended PMDC presentations at various professional meetings. Have teacher reactions been considered seriously by the project staff? Application of project results can be maximized with teacher assent.

Furthermore, the Panel believes that the project staff should themselves be concerned about the biases that seem to prevail in the written reports; that is, the apparently low opinion held by principal investigators of primary-level classroom teachers with regard to their knowledge about teaching primary-level mathematics, about primary-level children and about interpreting children's comments about mathematics. The written reports available to the Panel suggest that the project staff did not seek and did not want the input of teachers, either in discussing goals and needs or in participating in discussions and analyses of videotapes. The following are quotations from the PMDC Staff Reactions to the Formative Evaluation Report (June 1975): "One PI felt that a teacher with the experience of facing children daily could make certain unique contributions to the Project. Several PIs have negative feelings about this due to their previous experience in this area." (p. 25) "At one time during the course of the last Advisory Board meeting, the director raised the question of whether there should be an elementary teacher serving on the Board. It was pointed out at that time that perhaps we should recognize that the job of the elementary school teacher is to teach children and they should not be expected to go beyond this function." (pp. 26-27) That the project has begun to invite teachers (e.g., four 1/4-time teachers at the Georgia site this year) appears to be a function of external pressure to do so. If practicing classroom teachers become aware of the negativism of the project staff about their capabilities, then the results of the project cannot be expected to effect changes in the teaching and learning of mathematics. The Panel urges the project staff to consider a more substantial involvement of primary-level classroom teachers and parents in both advisory and cooperating roles.

Question 3: Does this investigation have a clear purpose and rationale?

The goals of the project are clearly stated in numerous forms. However, the goals are very broad, and there appears to have been a minimum amount of time expended on analyzing and restating the goals into manageable sub-goals or objectives. This non-specificity has allowed individual principal investigators to pursue their individual interests. There is little structuring that forces one activity (e.g., analysis of videotaped interviews to ascertain the status of children's thinking) to precede another (e.g., conducting related teaching experiments and research).

Therefore, it is not clear at this point that the goals of the project will be met in a fashion which will have an impact on the teaching and learning of mathematics at the primary level. The principal investigators are aware of the possible need for some added degree of specificity and for more coordination of efforts (e.g., as proposed in

Archambault's report) and may effect changes during the current second year of the project. However, it is with some concern that we question where the project is indeed going: will any set of usable, applicable results be generated?

Two questions which the Review Panel was asked to consider concern the assumptions, values, and goals of the project. Assumptions made by principal investigators about the capability of primary-level teachers have already been noted in the response to the previous question. Such an assumption might be attributed to the fact that virtually all of the project staff are persons who have a secondary-school teaching background; their lack of experience at the primary level presumably contributes to negative beliefs about the role which primary-level teachers could assume in the project. Are secondary school-oriented persons totally capable of analyzing ~~the~~ thinking processes of primary-level children and of structuring materials and lessons for teaching primary-level children?

While there is indication that the project was designed to explore how young children think about mathematics, it is also apparent that preconceived ideas have strongly influenced the directions pursued by individual investigators. This is evidenced, for instance, in the way the videotapes are analyzed; alternative conjectures as to why children respond as they do apparently are not considered. A Piagetian orientation is clear in the research being conducted by one investigator; the theoretical basis for other efforts is not clearly explicated. It would seem that the existence of preconceived ideas should be recognized and taken into account as various activities are pursued. For instance, if Piagetian theory is incorporated as a vital aspect of some studies, the relationship of Piagetian theory to other studies should be considered.

The concerns cited above all relate to the cohesiveness of the project, both as activities are conducted and as implications for classroom practice are considered. The relationship between the taped interviews and the teaching experiments is unclear: how the topics for interviews are decided, how the teaching experiments are coordinated, how the sequencing and structuring of the effort both within and between sites are coordinated, are points of concern. The role of the list of conjectures which have been developed or collected is also relevant to this concern. It appears that, at least in some instances, they were "created under pressure of time" (quoted from a staff meeting report) rather than as natural and almost-daily outcomes of the work with children. The list could profit from synthesis to encompass related points, from rewriting for clarity (and the addition of specifics about, for instance, characteristics of the children to whom each might apply), and, even more importantly, by deletion of those conjectures which are not conjectures but rather facts to those who have taught at the primary level.

Question 4: Is the content of the taped interviews and teaching experiments mathematically and psychologically sound?

In the written proposals and accounts of teaching experiments and research, the mathematical content appears sound. However, in the presentation of materials in some taped interviews and in some parts of several sets of materials for experiments, there is some question of appropriateness. One concern is with whether the use of the material is perceived by the children as the investigator intended it to be perceived. For instance, on one tape a box is used to "hide" objects representing the missing addend; it appears that children may be focusing less on the mathematics than on the hiding aspect of a game. A different type of concern arises with, for instance, a lesson in which six embodiments are used, one immediately following the other: are the procedures sufficient for collecting information on what this "massive" bombardment of materials does to children?

There appears to be a need for continued and increased interaction among the principal investigators in critiquing proposed activities (including interviews, lessons, and materials) to assure their appropriateness both psychologically and pedagogically, as well as in relation to project goals and objectives.

The whole idea of looking carefully at how children think and of trying to find effective strategies to promote mathematical understanding is excellent. The need for careful, accurate interpretation of information gained from the videotaped interviews has been noted. There is in addition a need to realize that the children may have difficulty in understanding what the interviewer is asking--they therefore answer a different question (sometimes they do this on purpose!).

The focus in each interview and each lesson is on a relatively small but generally important aspect of the mathematics curriculum. This narrowness of scope allows for thorough consideration from several points of view. Coordination of the project effort could facilitate the interpretation of information about each aspect and lead to the development of carefully explicated ideas for classroom and curriculum implementation.

Question 5: Are the procedures and content being used in the investigation educationally sound?

The Review Panel questions the educational soundness of an investigation into the learning and teaching of mathematics at the primary level if primary-level teachers are not cooperatively involved. Classroom teachers are a valuable source of data about the teaching and learning processes in mathematics.

Little evidence is available on the ways in which the project may consider the individual aptitudes, backgrounds, needs, and interests of children, or the resulting need to provide differentiated instructional strategies. While some conjectures refer to "low" or "average" students, little or no attention is given to the characteristics of individual children. One factor previously noted concerns the lack of consideration of the work and the research of those not on the project staff. On many points referred to in the documents reviewed there has been previous research. There is scanty reference to this research; it appears to have been considered most thoroughly in one or two of the reports on teaching experiments. Research has already provided substantial evidence on several of the conjectures which were raised. There has been research on, for instance, the effect of delaying instruction and the difficulty of mathematical sentences with the placeholder in various positions.

Principal investigators should be aware of explorations which have been and are being conducted at other centers. No reference was found in the documents reviewed to the extensive writing on interviewing by Brownell, for instance, or to the clinical investigations being conducted at, for instance, the University of Maryland. The proposal to focus on the development of a measurement-based curriculum first appeared with no comment that such a curriculum is being developed at the Wisconsin R & D Center; however the principal investigators are now beginning to consider the "failures" of that curriculum. Hopefully, they will also consider its "successes."

Reviewing the research and other literature should be a prime requisite at the beginning stages of a project so that it can be used to facilitate the work on a project. The reflections and knowledge acquired by other mathematics educators could be of aid to this project.

Question 6: Are the proposed and anticipated outcomes of the investigation desirable?

The outcomes of this project are somewhat unclear. While outcomes were considered in the proposal and presumably stated in the goals, the project staff wants to retain the flexibility to restate anticipated outcomes as the work progresses in various directions. As noted previously, the goals need to be reconsidered in terms of formulating objectives which can be attained.

The principal investigators, in the reaction to Archambault's report, defend their need to remain free of the restriction of such specification. To allow each person to "do his own thing" and hope that collectively a goal is reached may not be realistic. The investigators presumably realize this, as they take steps to assure increased coordination, communication, and cohesiveness.

Question 7: Do the proposed and anticipated outcomes present implementation problems for the schools?

One anticipated outcome of the project is the development of models to be used in helping teachers to acquire interview techniques. The videotaped interviews and interview techniques could be used by teachers with little special training. If interviews are to be conducted by classroom teachers, then teachers must "find" the time to do this.

Question 8: Are the costs for implementing the results of the investigation reasonable?

It is not clear at this stage what the plans for implementation of results or products of the investigation will be. Therefore, most of the subquestions are not applicable. However, there is one concern about the nonfiscal costs (e.g., psychological/social) that may be involved in the teaching experiments.

Children who are in an experimental program may need help in making the transition back to the regular classroom. This becomes particularly important as the length of time in an experimental program increases. Has the project staff made plans to insure a smooth transition?

Question 9: Is the management/organization plan adequate for realizing the objectives of the investigation?

Some concerns have been expressed by both the present Review Panel and earlier reviewers about the management/organization plan. One concern has focused on the need for administrators at both project sites. This concern may be met with the decision to have a site director at both locations. This plan can facilitate the coordination within the project and across the project sites.

Another concern is that the project staff is incomplete. No primary-level teachers, no lay persons, and few specialists outside the project have been given the opportunity to make suggestions or propose alternatives for the project. Despite the fact that project personnel state that they have "the breadth and depth of experience" necessary to meet all project goals; that they feel that the use of "so-called 'experts'" is implausible; and that they believe "it is important for us to rely on our own resources," we do not concur.

It is not clear what the role of the internal evaluator is. There is no evidence that the anticipated role of a "devil's advocate" is being fulfilled.

We believe that the report by the external evaluator can be of immense help to the project staff in clarifying and improving the project, despite the first reactions of the project staff to this evaluation.

D. 3. d: PMDC (Panel 1): Individual Panelists' Responses to 10th Review Question: <u>What are your general impressions of the curriculum?</u>

<u>NSF Staff Note</u>: Panel 1 submitted a general response of the whole panel which applies equally to all five curricula reviewed by Panel 1. In addition, one panelist submitted an individual comment which applies equally to all five curricula reviewed by Panel 1, and one panelist submitted individual comments on each curriculum.

Panel 1's common response:

In addition to expressing its opinions on individual projects, the panel wishes to express itself on curriculum projects in general. The following paragraphs describe issues that the panel feels strongly about and which we believe the NSF must take seriously in their deliberations regarding the Foundation's support of curriculum development.

<u>Long Range Implementation</u>

The Review Panel expresses a concern with respect to all projects in the area of long range implementation plans. Projects must make provisions for long term teacher education programs with local school districts to insure proper implementation and use. Lack of adequate commitment to this issue in the past has led to misuse, misconception and a questioning of the actual value of the project itself.

A project must make provision in its design to work with local school districts in providing a systematic plan for implementation which is mutually acceptable and cost effective for <u>both</u> the project and the local school.

Projects must also consider the implications of teacher education programs at the university level if the project is someday to become widely used. This must be considered by projects if the teaching strategy employed is divergent from current practices and in light of the fact that the local schools will be the recipients of teacher education programs.

<u>Parent Involvement</u>

The school and the home have one common concern from the beginning--<u>the child</u>. Therefore, education of children <u>must</u> be a teamwork

effort. The child cannot be the victim of a tug of war over who knows best for the child, because the result is frustration for teacher, parent and child. Instead of the three R's, the three C's need to be implemented. There must be communication, compromise and genuine concern between home and school.

Parents should and must be included from the beginning when curriculum materials are developed. However, care must be taken to remember that parents are for the most part lay people and should not be overwhelmed with educational jargon. Their contributions are important not only because of their concern and knowledge about children, but also because they are free of any constraints imposed by involvement in the professional educational establishment.

Child Development

It is generally agreed that the most effective curriculum materials are those which are adapted to the developmental level of the children for whom they are constructed. This means that in any group attempting to construct new curricula, there should be one or more persons who are solidly grounded in the field of child development. This was not always the case in the projects reviewed by the panel. As a consequence avoidable errors in curriculum construction were made and potential insights into the worth of particular materials were lost or not fully appreciated. NSF should seek to insure that child development skills and knowledge are represented in government-supported curriculum projects.

Use of Supplementary Curriculum Materials

Each of the curriculum projects evaluated by Panel 1 is considered a "supplementary" program in the sense that they do not intend to replace or supplant established subjects or their entire arrays of curricular goals. For example, none is the mathematics program or the science program.

However, when these programs are truly integrated with or complement established subject and skills areas, someone must confront the difficult problems of interrelating the components. Projects, we believe, have some responsibilities in seriously grappling with these issues and providing guidance to schools that goes beyond the narrow role of project implementation.

Development of process goals in problem solving behavior is a very important, and long neglected, objective of evaluation. However, other important objectives remain and should not be overshadowed. There

are certain emphases in, say, mathematical skills and concepts that inevitably result when the major focus is on the application of the subject to "real" problems. The important role of mathematics and scientific disciplines as a useful tool is stressed. The danger lies in the possible neglect of other aspects of the discipline. Those responsible for the curriculum should be certain that the unitary, systematic, structural nature of the subjects is not lost in the process. The knowledge and views obtained by the child should not be of disciplines as fragmentary bits and pieces however useful.

We merely state here that supplementary projects should not avoid responsibility for this difficult problem but should seriously award it continuous attention.

The Role of the Federal Government in Curriculum Development

The Federal Government clearly plays a leadership role in curriculum development, but the nature of that leadership needs to be carefully considered. For example, is it better to use federal resources to build programs at a regional and national level and then attempt to disseminate them to local school districts? Or would there be a better return by encouraging local school districts to improve their own programs through staff development and local curriculum projects that meet the needs of the community?

Teacher Involvement

The extent to which teachers are involved in the projects reviewed by the Panel varies greatly. Since elementary school teachers are the key to the effective outcomes of all projects for improved learning of children, the Panel strongly recommends that teacher involvement is necessary in all stages of planning, development, and implementation of the project efforts.

Representation of Women and Minorities

Project leadership and staff should be representative of a cross section of the educational community. Involvement of minority group members and women in the planning, development, implementation and governance or advisory tasks has been missing in some of these projects. Key personnel in at least two of the projects reviewed were almost exclusively white males.

In addition, it was also apparent that some key personnel were involved in more than one project. This overinvolvement of project staff not only limits the range of talents, abilities and insights available but also limits leadership of curriculum development to a small group. The panel believes that NSF should encourage project directors to have a broader representation of minorities, women and key professionals on curriculum projects than is apparent in these projects.

Panelist: Dr. James R. Okey

My only concern with our review is that we may have been too tough on the projects. Most had modest budgets to carry out their proposals yet we expected exemplary and complete needs assessments, research reviews, research studies, development efforts, implementation and dissemination plans, and readability studies to have been completed during the first or second year of the project. With the limited resources available to the projects, such thoroughness is impossible.

D. 4. a: AP: NSF Descriptive Information

PROJECT TITLE: Elementary Mathematics Project: University of Illinois Arithmetic Project (AP)

PROGRAM; Science Curriculum Development

PROJECT DIRECTOR: David Page (during active life of project); Current Project Director: Jack Churchill

INSTITUTION: Educational Development Center (formerly Educational Services, Inc.)

BUDGET: Total Granted: $1,525,210

Dates: 2/15/65 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Development of a series of courses in mathematics for teachers including films of unrehearsed classroom presentations.

PROJECT SUMMARY

OBJECTIVES:

The original recommendation memo (10/64) identifies the objectives of the project as follows:

> "The purpose of this project is to attempt to effect a major change in the way mathematics is taught in the elementary schools by producing a series of four courses in mathematics for teachers.... The courses for teachers will include:
>
> a) text and problem sequences, of the sort intended for use by students, designed to introduce teachers to both the mathematical content and the way of presenting it;
> b) descriptions of pitfalls and points likely to lead to difficulty in the classroom (e.g., division by zero, sign of product of signed numbers);
> c) problem sequences that have proved effective in presenting various ideas to children in grades kindergarten through six;

d) motion pictures showing unrehearsed classroom presentations (some continuous and some edited to illustrate various points) by teachers other than Professor Page and some expositions by Professor Page. The classroom films would be accompanied by written summaries and analyses of what occurred.

The collection of written and filmed material will be designed to be usable by groups of teachers without additional guidance. They will be tried out in local school systems and modified on the basis of these trials. It is envisioned that teachers of various degrees of competency will be able to make use of the courses. No texts for elementary pupils will be developed. Rather, the courses will present a range of problem sequences suitable for use with both existing and forthcoming texts; teachers will thus be free to proceed at their own pace in introducing the problem sequences into their courses."

ACTIVITY PLAN:

Filming was done in the Educational Services Inc.(later Educational Development Center) studios, making use of special techniques developed through considerable experience in educational filming, including some earlier experimental classroom films developed by Professor Page under an earlier NSF grant. The films and accompanying written materials were field tested in a variety of teacher education workshops and courses including NSF supported institutes.

ORGANIZATION AND MANAGEMENT PLAN·

The project has been under the management of Educational Services, Inc. and Educational Development Center with David Page as project director. The work was done under the guidance and with the assistance of a steering committee including prominent mathematicians, physical scientists, psychologists, and specialists in education.

UTILIZATION PLAN:

The materials developed were utilized in many teacher education courses on university and college campuses; in summer workshops, NSF institutes, and in regular pre-service teacher education courses. The materials have been made available through the grantee institution on a rental basis and have not been released through a commercial publisher.

HISTORY:

The project supported through this grant extends an earlier curriculum development project initiated in 1958 under Carnegie Foundation support. The University of Illinois Arithmetic Project created a quantity of material suitable for the instruction of elementary school children in mathematics and introduced hundreds of teachers to these materials through

NSF sponsored summer institutes. This project was designed to develop multi-media courses through which additional teachers could be introduced to the content and methods of the Arithmetic Project materials. While four courses were initially projected, the grant was subsequently modified to support the development of a single course which was to include approximately 30 films. This course, although not available commercially, has been and is continuing to be used in many teacher education programs.

PERSONNEL:

Dr. David Page, Project Director

D. 4. b: AP (Panel 1): Project Director's Response to 10 Review Questions

<u>NSF Staff Note</u>: The project director for the Arithmetic Project responded with descriptive material similar to that in section D. 4. a.

D. 4. c: AP (Panel 1): Panel Responses to 9 Review Questions

THE ARITHMETIC PROJECT

This project, initiated in 1958 and completed in 1970, produced "a package of in-service materials and activities specifically designed for use by local school systems in upgrading the understanding of content and the teaching of mathematics" by elementary school teachers. Responses to the following questions by the Review Panel have been based on an examination of the materials available to them (Guide for Course Leaders, twenty booklets and accompanying correctors' guides, films available, brochures) and a telephone conference with the current contact for the project.

Question 1: Is there a genuine need for these instructional materials?

Throughout the literature in mathematics education there are documented needs for continuing (in-service) teacher education in mathematics, both in content and teaching. More specifically, there is impetus for local school systems to assume responsibility for meeting this need since they are in a better position to select appropriate designs to serve their purposes. School systems are seeking alternative instructional materials that teachers can try immediately in the classroom. Materials produced by the Arithmetic Project are of this kind and thus can fulfill this need.

Question 2: Is there a market for these instructional materials?

On the basis of a published partial list of users (approximately 50) and the continuing six to twelve requests for information per week at the present time, there seems to be sustained interest in the materials. Present requests are thought to be prompted by the mailing of a brochure and/or the sharing of information between schools. No information is available to the Panel, however, to ascertain the number of recipients of this information. Since these materials have not been on the open market, it is difficult to predict the demand should they be placed on the market. According to the current contact for the project, a contract was negotiated with a publisher a year ago and is now being reviewed. One would assume that some type of market survey was done for the publisher to engage in negotiating a contract.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The Review Panel judges the materials to be a cohesive package for the purposes for which they were designed. The central theme of the project is that the study of mathematics should be an adventure. The project provides novel ways of doing mathematics--new sequences of interrelated problems that reveal significant mathematical ideas--that can motivate

teachers. Teachers using these sequences of problems can become better acquainted with mathematics. As a result of this better acquaintance, teachers can be expected to begin to make up and try out their own sequences in their classrooms. Children in turn can be motivated to do considerable amounts of computation in order to solve problems that interest them. As stated in General Information about the project, "improved computational skills usually follow work with its (Project) materials."

The project coordinator estimates that about one-half of the users do respond to the intent and goals of the project not only by using the materials themselves but also by trying out sequences of problems with children in their classrooms.

Question 4: Is the content of these instructional materials scientifically correct?

In the judgment of the Panel these materials appear to be both scientifically correct and current. They not only provide impetus for teachers to stimulate children who aspire to further study of mathematics and science but also provide pleasant experiences for all students who are studying mathematics. The materials do not, however, relate these mathematical ideas to applications or "real" problems. The content of these materials is focused upon ideas such as the effects of using rules in different orders, pattern searching, maneuvers on lattices, artificial operations, graphing equations with lower and upper brackets, simultaneous equations and number plane rules.

Question 5: Is the content of these instructional materials educationally sound?

According to the comments of users, these materials have been well received. Certainly the suggestions for improved teacher-student and student-student interactions in the classrooms, provisions for individual learning and opportunities to gain insights into children's thinking and reasoning are meritorious. Both teacher and student self-concepts in learning mathematics can be expected to be enhanced by the project's materials.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

These materials can be expected to provide motivation for learning mathematics, practice in computation, and geometric and arithmetic intuitions including laws of operations, and opportunities for creative thinking. The Review Panel supports these goals as desirable outcomes of effective mathematics programs for teachers and in turn for students. Perhaps even more important is the stimulus provided teachers for the development of different teaching strategies for the enrichment of mathematics instruction.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

Use of these materials by a school system seems dependent on having someone (school superintendent, mathematics consultant, high school mathematics department chairman, special teacher in mathematics) serve as a local agent. In practice, a school might initiate the use of the materials and persons from other schools join the group by sharing the cost of the program.

The present materials have resulted from revisions of earlier materials. These revisions were made based on information received from an extensive questionnaire with respect to needed changes to overcome any difficulties that were encountered in the use of the materials in the earlier versions. The length of the films although regarded by some users as too long, seems to provide for ample time for the comprehension of both the development of content understanding and teaching strategies.

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

At the present time, opportunity is provided for a trial workshop package at what seems to be a reasonable cost. This workshop package, which includes film rental, full instructions, and booklets for 25 persons, can be purchased for $48. If the total program is purchased, the cost of the workshop package is deducted from the cost of the total program. If not satisfactory, unused materials may be returned for full refund. What changes may be made in cost, should the publisher's contract be finalized, are unknown to the panel.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

Not relevant at this time.

D. 4. d: AP (Panel 1): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

NSF Staff Note: Panel 1 submitted a general response of the whole panel which applies equally to all five curricula reviewed by Panel 1. In addition, one panelist submitted an individual comment which applies equally to all five curricula reviewed by Panel 1, and one panelist submitted individual comments on each curriculum.

Panel 1's common response:

In addition to expressing its opinions on individual projects, the panel wishes to express itself on curriculum projects in general. The following paragraphs describe issues that the panel feels strongly about and which we believe the NSF must take seriously in their deliberations regarding the Foundation's support of curriculum development.

Long Range Implementation

The Review Panel expresses a concern with respect to all projects in the area of long range implementation plans. Projects must make provisions for long term teacher education programs with local school districts to insure proper implementation and use. Lack of adequate commitment to this issue in the past has led to misuse, misconception and a questioning of the actual value of the project itself.

A project must make provision in its design to work with local school districts in providing a systematic plan for implementation which is mutually acceptable and cost effective for both the project and the local school.

Projects must also consider the implications of teacher education programs at the university level if the project is someday to become widely used. This must be considered by projects if the teaching strategy employed is divergent from current practices and in light of the fact that the local schools will be the recipients of teacher education programs.

Parent Involvement

The school and the home have one common concern from the beginning-- the child. Therefore, education of children must be a teamwork

effort. The child cannot be the victim of a tug of war over who knows best for the child, because the result is frustration for teacher, parent and child. Instead of the three R's, the three C's need to be implemented. There must be communication, compromise and genuine concern between home and school.

Parents should and must be included from the beginning when curriculum materials are developed. However, care must be taken to remember that parents are for the most part lay people and should not be overwhelmed with educational jargon. Their contributions are important not only because of their concern and knowledge about children, but also because they are free of any constraints imposed by involvement in the professional educational establishment.

Child Development

It is generally agreed that the most effective curriculum materials are those which are adapted to the developmental level of the children for whom they are constructed. This means that in any group attempting to construct new curricula, there should be one or more persons who are solidly grounded in the field of child development. This was not always the case in the projects reviewed by the panel. As a consequence avoidable errors in curriculum construction were made and potential insights into the worth of particular materials were lost or not fully appreciated. NSF should seek to insure that child development skills and knowledge are represented in government-supported curriculum projects.

Use of Supplementary Curriculum Materials

Each of the curriculum projects evaluated by Panel 1 is considered a "supplementary" program in the sense that they do not intend to replace or supplant established subjects or their entire arrays of curricular goals. For example, none is the mathematics program or the science program.

However, when these programs are truly integrated with or complement established subject and skills areas, someone must confront the difficult problems of interrelating the components. Projects, we believe, have some responsibilities in seriously grappling with these issues and providing guidance to schools that goes beyond the narrow role of project implementation.

Development of process goals in problem solving behavior is a very important, and long neglected, objective of evaluation. However, other important objectives remain and should not be overshadowed. There

are certain emphases in, say, mathematical skills and concepts that inevitably result when the major focus is on the application of the subject to "real" problems. The important role of mathematics and scientific disciplines as a useful tool is stressed. The danger lies in the possible neglect of other aspects of the discipline. Those responsible for the curriculum should be certain that the unitary, systematic, structural nature of the subjects is not lost in the process. The knowledge and views obtained by the child should not be of disciplines as fragmentary bits and pieces however useful.

We merely state here that supplementary projects should not avoid responsibility for this difficult problem but should seriously award it continuous attention.

The Role of the Federal Government in Curriculum Development

The Federal Government clearly plays a leadership role in curriculum development, but the nature of that leadership needs to be carefully considered. For example, is it better to use federal resources to build programs at a regional and national level and then attempt to disseminate them to local school districts? Or would there be a better return by encouraging local school districts to improve their own programs through staff development and local curriculum projects that meet the needs of the community?

Teacher Involvement

The extent to which teachers are involved in the projects reviewed by the Panel varies greatly. Since elementary school teachers are the key to the effective outcomes of all projects for improved learning of children, the Panel strongly recommends that teacher involvement is necessary in all stages of planning, development, and implementation of the project efforts.

Representation of Women and Minorities

Project leadership and staff should be representative of a cross section of the educational community. Involvement of minority group members and women in the planning, development, implementation and governance or advisory tasks has been missing in some of these projects. Key personnel in at least two of the projects reviewed were almost exclusively white males.

In addition, it was also apparent that some key personnel were involved in more than one project. This overinvolvement of project staff not only limits the range of talents, abilities and insights available but also limits leadership of curriculum development to a small group. The panel believes that NSF should encourage project directors to have a broader representation of minorities, women and key professionals on curriculum projects than is apparent in these projects.

Panelist: Dr. James R. Okey

My only concern with our review is that we may have been too tough on the projects. Most had modest budgets to carry out their proposals yet we expected exemplary and complete needs assessments, research reviews, research studies, development efforts, implementation and dissemination plans, and readability studies to have been completed during the first or second year of the project. With the limited resources available to the projects, such thoroughness is impossible.

D. 5. a: MMP: NSF Descriptive Information

PROJECT TITLE: Webster-Syracuse Elementary Mathematics Project: Madison Project Films (MMP)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR:

Current (as of 12/75):

Dr. Robert Spencer
Webster College

During Active Life of Project:

Dr. Robert B Davis
University of Illinois at Urbana-Champaign
(formerly at Syracuse University)

INSTITUTION: Webster College

BUDGET: Total Granted: $964,045

Dates: 8/24/61 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Preparation and distribution of films showing actual classroom lessons and ~~development and~~ testing of related written materials for teacher education.

PROJECT SUMMARY

OBJECTIVES:

The original recommendation memo (7/61) suggested that this project would be directed toward the development of elementary school curriculum materials to follow those previously produced under the Madison Project. The materials were to include: (1) a further development of axiomatic algebra for polynomials; (2) work with matrices and vectors; (3) the construction of various axiomatic geometric systems; (4) perhaps work in trigonometry; (5) perhaps some specific study of the function concept; etc.

The first amendment recommendation (9/62) restated the purpose as follows:

"The purpose of this project is to help improve instruction in mathematics by producing a series of films designed to give training for the teaching of mathematics in elementary schools and by developing instructional materials relating mathematics

and science for junior high schools. The films will present actual classroom instruction by the project director and possibly other teachers. The project has produced a body of instructional materials in algebra for use in elementary schools as a one-day-per-week supplement to regular courses. The films and accompanying written materials for teachers are designed to make it possible for elementary school teachers without any considerable previous training in mathematics to teach the new mathematical content in ways that encourage invention and discovery on the part of the student. The films to be produced under this grant will be combined with films produced earlier with local support into a series which will include both continuous classroom sequences and intermittent sequences showing development over greater lengths of time."

ACTIVITY PLAN:

The activity plan varied throughout the life of the project but was consistently directed toward teacher education activities which included, in addition to the development of actual classroom lessons, many in-service teacher workshops, the development of comprehensive teacher commentaries to accompany the films, pilot testing of the teacher training packages in both in-service and pre-service contexts, and other dissemination and implementation activities.

ORGANIZATION AND MANAGEMENT PLAN:

The Madison Project, in addition to funds provided under this grant, has received support for closely related activities from NSF institute grants, the Ford Foundation, and the U.S. Office of Education. Organization and management plans unique to this grant are difficult to separate from the overall effort. The operational aspects of the project have been under the direction of the Project Director, Robert Davis. Dr. Davis was located part-time at both Syracuse University and Webster College during the earlier years of the grant and at the University of Illinois during the later years. In addition he conducted in-service institutes and workshops at many different sites during some portions of the life of the grant. Fiscal management of the grant was always through Webster College.

UTILIZATION PLAN:

The films and related materials developed under this grant were designed for utilization in both in-service and pre-service teacher education programs. During the life of the project, the packages were tested in NSF institutes, in undergraduate pre-service programs at Webster College, Syracuse University, the University of Illinois, and in many in-service teacher workshops. The packages have been used by many colleges and universities in similar teacher training activities.

Twelve of the films are available commercially:

1. Readiness for Place Value Numerals
2. A Sixth Grade Lesson on Place Value Numerals
3. Subtraction Using Beans
4. Addition and Multiplication Using Plastic Washers
5. Addition and Division Using Beans and Beansticks
6. Subtraction and Division Using Beans and Beansticks
7. Experience with Fractions: Suppose It Comes Out Even?
8. Experience with Fractions: Suppose It Doesn't Come Out Even?
9. Fractions and the Meaning of Division
10. Fractions on the Number Line Using String
11. The Number Line Using the Overhead Projector
12. Area Using Geoboards

The films listed above are distributed by Houghton-Mifflin and are designed as a "series" which tend to develop a common theme. These films were developed by editing films of classroom lessons to delete material extraneous to that theme. Additional "series" have been projected utilizing similar editing of the many individual lesson films available. The exact nature or titles or, indeed, whether such series have actually been developed cannot be determined on the basis of e dence in the files at this time.

In addition to the series of films available commercially, two tightly sequenced courses, In-Service Course I and In-Service Course II, which combine written material with film were produced and have been widely tested in teacher training programs.

An unspecified but apparently large number of individual films and videotapes have also resulted from this project. These materials might conceivably form the basis for additional utilization activities.

The termination date has been extended through additional amendments without additional cost to the current termination date of March 31, 1976.

In December 1975 the project director was changed to Dr. Robert Spencer of Webster College.

PERSONNEL:

Dr. Robert B. Davis, Project Director
Director of Curriculum Laboratory
University of Illinois at Urbana-Champaign

D. 5. b: MMP (Panel 1): Project Director's Response to 10 Review Questions.

<u>NSF Staff Note</u>: The project director for the Madison Project Films did not provide a response for the panel.

D. 5. c: MMP (Panel 1): Panel Responses to 9 Review Questions

MADISON PROJECT FILMS

Since 1961 the Madison Mathematics Project has been concerned with curriculum change in elementary school mathematics. That portion of the project supported by the National Science Foundation was the production of 16 mm films showing children in classrooms. The films, used primarily in in-service teacher education, exhibit both the pedagogical approach and the mathematical content central to the project.

The following review of the Madison Project Films, according to the questions suggested by the National Science Foundation, is a mix of opinion, personal experiences of Review Panel members, a telephone conversation with the project director and examination of a limited number of documents and films.[1]

Question 1: Is there a genuine need for these instructional materials?

There is, has been and continues to be a genuine need for materials to enhance the continuing education of teachers. These films capture a spirit of inquiry, of exploration and discovery learning--alternatives in classroom organization for learning and teaching.

It is difficult to say now many teachers these materials could be expected to reach. The director reports that two or three inquiries about the materials are received each day at the University of Illinois Curriculum Laboratory. Historically, the materials have been used in staff development programs in urban and suburban school districts and in university teacher education programs.

Question 2: Is there a market for these instructional materials?

The program has sustained itself to the extent indicated above without recent advertising or other dissemination efforts. According to the director, requests come from former users of the materials as well as a few new or first-time users. He anticipates that the materials will continue to be used at least at the present level.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The stated purpose of the materials, according to information in the evidence packet, is this: "For in-service teacher education workshops, packages of films, tapes, printed materials, and activities were designed

[1] "Madison Mathematics Project" in Course Curriculum Improvement Projects, National Science Foundation; film "Creative Learning Experiences"; and Davis, Robert B., Teachers Commentary, The Madison Project Films.

to introduce teachers to the simpler parts of arithmetic, algebra and analytic geometry, in a discovery approach like that used by the children." Assumptions inferred directly from the films themselves and the description of the printed materials are as follows: In-service teachers observing teaching strategies and mathematical content employed in the films, discussing what they have seen, and experimenting with both strategies and content will be motivated to try similar exploratory activities and teaching strategies in their own classrooms.

Question 4: Is the content of these instructional materials scientifically correct?

The materials appear to be both scientifically accurate and current. The content is aimed toward increasing the scientific knowledge of teachers in arithmetic, algebra and coordinate geometry.

Question 5: Is the content of these materials educationally sound?

It is the opinion of the Review Panel that the content of these materials is educationally sound. A few studies have been done of the impact of teacher education programs in which these materials were used. The studies--in particular, one by Robert Dilworth in California[2] -- report favorable reactions from teachers and gains in mathematics performance scores of students.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

Even though the films were made several years ago the pedagogy and problem-solving approaches used are still quite relevant. The proposed outcomes of increased student-teacher interactions in a spirit of inquiry and discovery learning are desirable, as is the increased knowledge in mathematics among teachers and students. In the judgment of the panel, these materials have indeed had an impact on many teachers and children. The impact has gone beyond those in direct contact with the project. The innovative ideas in pedagogy and content have been diffused throughout teacher education programs and school curricula.

Question 7: Do these instructional materials present implementation problems for the schools?

Implementation of these materials depends (1) on the commitment of schools to leadership development and the continuing education of teachers and (2) on the commitment of schools to alternatives in curriculum content

[2] Dilworth, Robert P. and Warren, Leonard. Final Report: Specialized Teacher Project, 1971-72. Sacramento: California State Department of Education, 1973.

and teaching styles. Implementation of the ideas in these materials--in particular the group involvement and interaction among children depicted in the films--may be difficult in very restrictive classroom settings.

Question 8: Are the costs for implementing these instructional materials reasonable?

The cost is $4.00 per teacher handbook, plus nominal rental and handling charges on the films. An additional cost may be a consultant's fee for the person who would direct the in-service course. The cost seems to be reasonable.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

Not applicable.

D. 5. d: MMP (Panel 1): Individual Panelists' Responses to 10th Review Question: <u>What are your general impressions of the curriculum?</u>

<u>NSF Staff Note</u>: Panel 1 submitted a general response of the whole panel which applies equally to all five curricula reviewed by Panel 1. In addition, one panelist submitted an individual comment which applies equally to all five curricula reviewed by Panel 1, and one panelist submitted individual comments on each curriculum.

Panel 1's common response:

In addition to expressing its opinions on individual projects, the panel wishes to express itself on curriculum projects in general. The following paragraphs describe issues that the panel feels strongly about and which we believe the NSF must take seriously in their deliberations regarding the Foundation's support of curriculum development.

<u>Long Range Implementation</u>

The Review Panel expresses a concern with respect to all projects in the area of long range implementation plans. Projects must make provisions for long term teacher education programs with local school districts to insure proper implementation and use. Lack of adequate commitment to this issue in the past has led to misuse, misconception and a questioning of the actual value of the project itself.

A project must make provision in its design to work with local school districts in providing a systematic plan for implementation which is mutually acceptable and cost effective for <u>both</u> the project and the local school.

Projects must also consider the implications of teacher education programs at the university level if the project is someday to become widely used. This must be considered by projects if the teaching strategy employed is divergent from current practices and in light of the fact that the local schools will be the recipients of teacher education programs.

<u>Parent Involvement</u>

The school and the home have one common concern from the beginning--<u>the child</u>. Therefore, education of children <u>must</u> be a teamwork

effort. The child cannot be the victim of a tug of war over who knows best for the child, because the result is frustration for teacher, parent and child. Instead of the three R's, the three C's need to be implemented. There must be communication, compromise and genuine concern between home and school.

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Use of Supplementary Curriculum Materials

Each of the curriculum projects evaluated by Panel 1 is considered a "supplementary" program in the sense that they do not intend to replace or supplant established subjects or their entire arrays of curricular goals. For example, none is the mathematics program or the science program.

However, when these programs are truly integrated with or complement established subject and skills areas, someone must confront the difficult problems of interrelating the components. Projects, we believe, have some responsibilities in seriously grappling with these issues and providing guidance to schools that goes beyond the narrow role of project implementation.

Development of process goals in problem solving behavior is a very important, and long neglected, objective of evaluation. However, other important objectives remain and should not be overshadowed. There

are certain emphases in, say, mathematical skills and concepts that inevitably result when the major focus is on the application of the subject to "real" problems. The important role of mathematics and scientific disciplines as a useful tool is stressed. The danger lies in the possible neglect of other aspects of the discipline. Those responsible for the curriculum should be certain that the unitary, systematic, structural nature of the subjects is not lost in the process. The knowledge and views obtained by the child should not be of disciplines as fragmentary bits and pieces however useful.

We merely state here that supplementary projects should not avoid responsibility for this difficult problem but should seriously award it continuous attention.

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The Federal Government clearly plays a leadership role in curriculum development, but the nature of that leadership needs to be carefully considered. For example, is it better to use federal resources to build programs at a regional and national level and then attempt to disseminate them to local school districts? Or would there be a better return by encouraging local school districts to improve their own programs through staff development and local curriculum projects that meet the needs of the community?

Teacher Involvement

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Representation of Women and Minorities

Project leadership and staff should be representative of a cross section of the educational community. Involvement of minority group members and women in the planning, development, implementation and governance or advisory tasks has been missing in some of these projects. Key personnel in at least two of the projects reviewed were almost exclusively white males.

In addition, it was also apparent that some key personnel were involved in more than one project. This overinvolvement of project staff not only limits the range of talents, abilities and insights available but also limits leadership of curriculum development to a small group. The panel believes that NSF should encourage project directors to have a broader representation of minorities, women and key professionals on curriculum projects than is apparent in these projects.

Panelist: Dr. James R. Okey

My only concern with our review is that we may have been too tough on the projects. Most had modest budgets to carry out their proposals yet we expected exemplary and complete needs assessments, research reviews, research studies, development efforts, implementation and dissemination plans, and readability studies to have been completed during the first or second year of the project. With the limited resources available to the projects, such thoroughness is impossible.

D. 6. a: SAM: NSF Descriptive Information

PROJECT TITLE: Source Book in Applied Mathematics (SAM)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: (Initial) Alex Rosenberg, Cornell University
(Since 9/75) D. Bushaw, Washington State University

INSTITITUTION: Mathematical Association of America

DEPARTMENT: Washington State University

BUDGET: Total Granted: $62,300
Dates: 12/10/73 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Development of source book of mathematical applications for secondary school mathematics use.

PROJECT SUMMARY

OBJECTIVES:

THE PROJECT. NCTM and CUPM propose to produce a source book which will contain material of the following kinds:

(1) Background material for the teacher. A discussion of the philosophy and technique of model building, including various sorts of models, what is involved in constructing a model, and the relations between models and the real world; completely worked out examples of model construction.

(2) Material suitable for use in the classroom.

a) New applications which require approximately one class period for presentation; modeling questions would also be considered in this section, but in less detail than in part (1).

b) Very simple examples of real world situations which supplement assignments or aid the teacher in motivating new concepts.

c) Applications which are suitable for science projects or are useful in other independent study situations.

(3) Annotated bibliography. Readily available articles on model building and applications.

ACTIVITY PLAN:

GATHERING MATERIAL FOR THE SOURCE BOOK. Notices will be placed in The Mathematics Teacher, Mathematics Teaching, Scientific American, American Mathematical Monthly, Mathematics Magazine, The Two Year College Mathematics Journal, SIAM Review and other similar journals, soliciting suitable applications.

In order to obtain additional examples from the physical, life, and social sciences, two mathematicians will search appropriate journals for articles from which appropriate examples may be extracted.

To obtain good examples of the use of mathematics in everyday situations, two people will be sent "into the field," where mathematics is being used. They will interview arpenters, grocers, draftsmen, city planners, pollution control engineers, etc., to identify the ways in which these people use mathematics.

EDITING THE MATERIAL. All material will first be processed by the CUPM Central Office staff. Duplications of articles and examples will be eliminated, inappropriate contributions will be set aside, and the remaining examples will be classified and distributed to the Editorial Board for their examination. The Editorial Board will examine the examples collected and will choose those from which the final selection will be made. Once the nature and strengths of the available examples become clear, the Board will determine the final format of the book and will select an editor to complete the task, subject to their approval. The editor will be named and brought into policy discussions as soon as possible.

ORGANIZATION AND MANAGEMENT PLAN:

The Director and Central Office staff will handle the administrative affairs of this project and provide coordination for it. They will make all arrangements for meetings, prepare minutes, and provide all the necessary supporting services. The CUPM Executive Director will be in charge of original evaluation and classification of the applications as well as preliminary editorial work. The CUPM Central Office staff will supervise the printing and distribution of the resulting document. It is only in virtue of the many services provided by the Central Office that it will be possible for NCTM and CUPM to call upon distinguished mathematicians and mathematics educators who have many pressing demands on their time, to serve on this project.

UTILIZATION PLAN:

Distribution and evaluation of the source book. Considering ~~the nature~~ of this book, we do not contemplate publishing a final edition until a preliminary version has been circulated to secondary school teachers for comments and evaluation, at least partially through classroom testing. We propose to publish a preliminary first edition of 1,500 copies. It is estimated that the printing cost will be \$3.00 per copy and the distribution cost \$1.00 per copy. We are therefore asking that \$6,000 be placed in a revolving fund to print and distribute two more sets of 1,500 copies.

HISTORY:

Background. The original proposal from MAA for a joint project of the National Council of Teachers of Mathematics (NCTM) and the Committee on the Undergraduate Program in Mathematics (CUPM) was submitted in March, 1972. This proposal was a request for support for the production of a source book for secondary school teachers of mathematics on applications of mathematics to a variety of academic disciplines and to situations from everyday experiences.

The proposed project was not supported in FY 73 because funds were not available. However, the Materials and Instruction Development Section considered the project to be of high priority. One reason for this high priority was the current attention to the need for including applications of mathematics in secondary school programs. This need was apparent in all three mathematics education conferences supported by NSF during the summer of 1973.

PERSONNEL:

The project director is Dr. D. Bushaw, Professor of Mathematics at Washington State University. He is assisted by the Editorial Board consisting of six mathematicians--Professor Max Bell, University of Chicago; Professor Arthur Engle, Ludwigsburg College; Professor Jack Forbes, Purdue University; Dr. Henry O. Pollak, Bell Laboratories; Professor Maynard Thompson, Indiana University; Professor Zalman Usiskin, University of Chicago. Professors Bell and Thompson will act as co-editors of the sourcebook.

D. 6. b. SAM (Panel 2): Project Director's Response to 10 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The assessment of needs for this project was made before the project began, and is summarized in the proposal (see especially pages 2-3 and 17-22). There is still ample evidence that realistic applications of mathematics receive far too little attention in pre-college mathematics curricula. One of the causes is that, in spite of the fact that real and potential applications of mathematics are all around us, it is extremely difficult to identify suitable examples, to formulate them in a way that preserves their authenticity while putting them within the range of the student, and to gather them into collections that provide broad, thorough, and balanced coverage. Presumably because of these difficulties, no such collections now exist.

Expressions of need for a sourcebook of this kind frequently come to our attention. One of the stronger expressions that have come to light since our proposal was drafted is a passage from the Report of the Conference on the K-12 Mathematics Curriculum, Snowmass, Colorado June 21-June 24, 1973, which we quote here in part:

Recommendation 1. There be constituted a task force made up of mathematicians, mathematics educators, representatives from industry, teachers, and students to develop and disseminate a comprehensive collection of examples of applications suitable for grades K-12.

Discussion. It is suggested that these applications be organized in terms of the usual strands in the curriculum, i.e., number, geometry, operations on rational numbers, solving algebraic equations, etc., and that they be organized according to grade level and type of application. The styles of presentation of the examples should vary from simple structured problems to open-ended unstructured situations that may require an interdisciplinary approach, i.e., the student may need to use information from fields other than mathematics.

A number of such applications are already available.... However, these materials are incomplete, e.g., insufficiently diverse, and not adequately organized for easy classroom use....

This collection of examples would not only directly help the teacher in the classroom, but would have the indirect benefit of providing incentive and direction for authors of school textbooks...., (pp. 36-37).

The present project does not meet these specifications exactly, but the appearance of its product should satisfy the need expressed in this recommendation, at least as far as grades 7-12 are concerned.

Directly or indirectly, the materials could ultimately reach the great majority of students in grades 7-12. If enough teachers take advantage of the materials themselves, they could reach many students almost directly; by way of their influence on teachers and textbook authors, they could someday affect the mathematical experiences of almost all future students.

There are no satisfactory alternative instructional materials in this area. There is a great deal of raw material, but as the above-quoted passage in the Snowmass Report suggests, the results of previous attempts to reduce this material to a form appropriate for the purpose at hand are incomplete and otherwise unsatisfactory.

In general, the need for these materials, and for the attitude toward mathematics they will embody, is great. For lack of such materials, generations of students, while spending many hundreds of hours on the study of mathematics, have all too often missed the crucial relationships between this subject and other aspects of life. They often acquire the tools, but do not know how to apply them or even to appreciate their immediate and potential usefulness, not only in the sciences and technology but in everyday life. The consequences of this situation are too familiar to require comment here.

Question 2: Is there a market for these instructional materials?

As we have already emphasized, no other products exist that can adequately meet the need.

The materials are not intended to fill a slot in the curriculum, but to enrich and influence the evolution of the style and content of the curriculum throughout grades 7-12. We hope that some teachers and schools will find ways to make especially intensive use of the materials, e.g. in special projects and miniterms, but this will not be their primary role. They will constitute a resource to which a dedicated teacher can turn on a day-to-day basis for help with the effective implementation of existing curricula.

The materials will be disseminated in an inexpensive printed form. Their availability will be publicized by a broad advertising campaign through the channels of MAA, NCTM, and NCTM affiliates, and in other ways. (Indeed, the project has already been widely publicized in the periodical literature and at national and other meetings of mathematics educators.) After the first cycle of production, which is already funded, the continued printing and distribution of these materials should be self-supporting and require no further funding from NSF or elsewhere.

To the best of our knowledge, the free market has made no serious attempt to respond to the need for these materials. The most likely explanation is that if any commercial publishers considered the possibility at all, they correctly assessed the difficulty of the undertaking and were unwilling to make the necessary investment.

We have made no systematic market studies. Since the Sourcebook will be aimed primarily at the teacher, the potential market cannot be compared with that, say, for an exciting new series of textbooks. Nevertheless, we would like to think that because of the uniqueness, versatility, low cost, and usefulness of the Sourcebook eventually a copy will find its way into every junior or senior high school in the country, if not on the desk of every mathematics teacher in those schools. Even allowing for a considerable component of wishful thinking here, there is clearly a significant potential market. It is also quite possible that the Sourcebook would be in demand as a learning resource in connection with pre-service and in-service teacher training.

It is not clear how the appearance of the Sourcebook could have any effect on the market for existing instructional materials. Of course, we hope that it will contribute to a climate that will ultimately favor certain kinds of instructional materials being preferred to others, but it would not be in direct competition with any of them.

Question 3: <u>Do these instructional materials possess a clear purpose and rationale?</u>

The purpose and rationale of the Sourcebook have been indicated in the proposal and <u>passim</u> above. Explicitly, we assume:

a) that both the ideas and techniques of mathematics form an integral part of our cultural heritage, not least because of their manifold relevance to and usefulness in dealing with the problems of modern society, both at the technical level and in everyday life;

b) that mathematical teaching at all levels should emphasize this aspect of mathematics and equip students, in attitude as well as knowledge, to avail themselves of the power of mathematics in practical affairs;

c) that this is particularly important at the secondary level, where students typically have their first and in many cases their last significant educational experience with any mathematics that goes beyond the relatively concrete, numerical level;

d) that due attention to this side of mathematics is not only an important goal in itself but may also work powerfully in motivating students to study mathematics in all its aspects;

e) that a major barrier to the implementation of the above assumptions is a severe shortage of sound examples to serve not only as educational material but also as prototypes for the generation of further material of the same general character;

f) that such examples should be interesting, realistic, mathematically sound, and compatible with accepted curricula.

The immediate goal of the project is to assemble a collection of materials satisfying the need that follows from these assumptions. The ultimate goal is to contribute to the improvement of both the content and the form of a student's experiences with mathematics.

Especially because of the introductory and explanatory matter that will accompany the problems in the Sourcebook, the assumptions, goals, and values underlying the materials will be clear from the Sourcebook itself.

Question 4: Is the content of these instructional materials scientifically correct?

A special effort is being made to assure that the data in the problems will be, wherever possible, not only realistic but real. Problems of the "daily life" type are in many cases based on actual experiences of the contributors, and problems of a more technical nature are checked against, if not actually drawn from, recent expert accounts of the areas of application in which they arise. Some problems invite students to gather their own data, thus adding a dimension to the experience while enhancing the sense of authenticity of the problem. (However, we avoid suggesting that students involve themselves in data-gathering activities that serve no instructional purpose and may be fitly described as mere "busy work.")

As mentioned earlier, the collection as a whole will cover the whole range of secondary mathematics and a very wide range of human activities and interests, from cooking and gardening to art and astronomy. Accuracy and realism will not be sacrificed to brevity or simplicity, but special value will be placed on problems that can be stated relatively briefly and in a self-contained manner. Explicit and practical references will be given in those instances where a certain specialized nonmathematical background is required.

Of course, pains will be taken to assure that the mathematical side of the materials is completely correct and expressed, without pedantry, in conformity with the best contemporary mathematical usage.

Question 5: Is the content of these instructional materials educationally sound?

No adverse reactions (except, perhaps, expressions of the inevitable resistance by a few people to change in all its forms) are expected. On the contrary, the philosophy of this project is very much in line with the national tradition of practicality and the high value traditionally attached to problem-solving "know-how." To the extent that this project may affect the overall tone of mathematics instruction, it should be expected to make some contribution to a general reconciliation of the general public with the mathematics curriculum, and thus to a better climate, both at school and at home, for learning mathematics.

It must be admitted that not all of these materials will be equally accessible to all students. Some of the problems, by their very nature, require above-average cognitive skills and in some cases real ingenuity. We are nevertheless well aware of the special needs of slow learners, disadvantaged students, and others for whom mathematics is frequently hard. We are especially concerned about including materials that will interest, inform, and encourage students in just these groups. We also believe, on the basis of good testimony and our own experiences, that problems of the kind featured in the Sourcebook, precisely because of their relatively worldly and concrete character, may offer new opportunities for success to many students whose previous relationship to mathematics has been a history of defeats because of emphasis on the more abstract side of the subject.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The answer to this question is implicit, if not explicit, in answers to the preceding questions. We see these materials as a contribution toward the reintegration of school mathematics with the rest of the student's present and future experience--a step toward the restoration of "normal relations" between the youth (and eventually the whole population) of this country and the pleasures and powers of mathematics. We are not so naive as to suppose that even an incomparably more massive effort would be sure to attain this goal, but to the extent that the outcomes of the present project are significant, we expect them to be significant in that direction. It may thus be one element of a general trend toward the rehabilitation of mathematics in the eyes of those (among students, teachers, school administrators, parents, and the public at large) who have been disturbed by what they perceive--sometime rightly--as the excesses of recent trends in mathematics education.

Students, in particular, may be expected to acquire a more balanced view of mathematics and a more effective grasp of its capabilities.

The members of the editorial group responsible for the Sourcebook are well aware of the possibility of overt or unintentional bias and stereotyping in instructional materials, even in such a comparatively impersonal subject as mathematics. The fact that we are dealing with many situations of daily life does expose the enterprise to certain risks. Our objective is to keep the materials as free as possible of anything that would suggest or reinforce any pernicious stereotypes related to sex, race, ethnic origin, religion, or socio-economic status.

Many problems will inevitably include elements closer to the experiences and aspirations of some students than to those of others; but while the individual problem may sometimes lack universality, the Sourcebook as a whole is intended to be broadly representative in this respect also; and the sensitive teacher, by selection and emphasis, should know how to adapt the content of the Sourcebook to any special cultural or instructional environment.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

No. These materials should fit very easily into any organizational structure, and teachers with a reasonable level of general competence and a commitment to program inprovement should require no special training to use them. Costs will be minimal, and such special learning resources as use of the Sourcebook may require will normally be found in the student's usual home and school surroundings. Optional classes, e.g., for bright students, are a possibility, but the Sourcebook will be planned primarily for flexible use in the usual curricula. In short, we see no material barriers to the implementation of these materials.

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

They are not only reasonable, but minute. The Sourcebook will be published in as inexpensive a format as is consistent with the purposes for which it is intended, and sold at or near cost. The price is unpredictable because the size of the book is still not known and printing costs are fluctuating; but a price in the neighborhood of five dollars seems likely.

Teachers may want to reproduce some of the materials for distribution to their classes, but the cost of doing so should be well within the amounts usually budgeted for such activities.

No other associated costs are foreseeable, and at present there is no other way the same need could be met by an individual teacher or school district without incomparably greater cost.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

The raw materials for this project have been obtained by general appeals published in many scientific and educational periodicals, and announced at large meetings; by written personal appeals to hundreds of individual colleagues who were thought likely to contribute; by direct personal appeals to educators and students of education, in some instances within the framework of other NSF-supported projects; by interviews with lay people in a great variety of occupations; from a wide-ranging search of scientific, technical, and general publications; from personal experiences of members of the editorial group and their associates; and by whatever other means have come to hand. The progressively accumulating compilations of problems that result are submitted to repeated criticism and revision by members of the editorial group. Considerable sections of the material have been discussed at length with practicing secondary educators.

In line with the proposal, the first version of the completed Sourcebook will be followed by a questionnaire whereby the teachers who will have had an opportunity to see and use it will be asked to assist in its evaluation.

The two editors, of course, will share a special responsibility for getting the material into a form suitable for reproduction.

Altogether, the preparation of the Sourcebook has turned out to be a challenging task, and has already involved more than one major unforeseen difficulty. It now appears that the project does appear to be understaffed. The members of the editorial board are not numerous, and they all have heavy commitments besides this project. Nevertheless, the work is proceeding, and in spite of some disappointments and delays we hope to have the materials in something approaching final form sometime in the summer of 1976.

Question 10: <u>What are your general impressions of the curriculum?</u>

The editorial group has never doubted the need for or the potential value of the Sourcebook. There have been moments of discouragement because returns from our various searches for raw materials were sometimes disappointing in quantity and quality, and we ourselves have not always been able to give the project as much time per week as we would have liked.

We see these difficulties not as indications that the project was misconceived, but rather as evidence that the task is, to an even greater extent than we had expected, a matter of breaking new ground; and the results should be all the more valuable.

D. 6. c: SAM (Panel 2): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The project quotes an impressive number of comments from well-known people on the need for more work in applications. These include some by Beberman, Rosenbloom, Georgescu, Bazan, Matei, Banescu, Engel, and Pollack. There is reference to Burns' study on attitude towards applications and a report of the Snowmass Conference. There are letters of support from NCTM and CUPM, and there is evidence of grass roots support through resolutions proposed at NCTM delegate assemblies. It appears that many teachers want someone to provide them with examples of the way in which mathematics is used in everyday situations. Frequent articles and complaints about the students' lack of fundamental skills are sometimes really directed at their inability to apply them to real situations.

There is no comprehensive collection of applied problems such as the project proposes. Those that exist in textbooks are usually few in number, contrived, and have little real application; or, if the examples are authentic, the mathematics is usually trivial. There are books on applications in specific disciplines, but these are usually too technical for use in secondary schools. The proposed Sourcebook would require no technical background. There is certainly no collection of applications that are cross-referenced with specific mathematics skills.

There should be a great demand for the book from both publishers and teachers. Some teachers may use the problems as a guide to writing other problems of the same type. An increase in the use of such problems in the classroom should give students a better understanding of the interdependencies of mathematics and other disciplines. Students are often told that these interdependencies exist, but are rarely shown why or how.

This project is very timely. It should be well-received by mathematics educators, parents, administrators, and the business and industrial communities. The project taps the minds of some of the best qualified people in the fields of mathematics and its applications. These are people who are also talented in bringing the two fields together. Their reputation will go a long way toward insuring the acceptance of the work.

Question 2: Is there a market for these instructional materials?

These materials will in all probability have wide market appeal to teachers by virtue of the:

a. breadth of disciplines which they represent

b. variety of problems for a wide spectrum of student abilities

c. inclusion of an authoritative bibliography

d. endorsement by NCTM and MAA-CUPM

e. lack of any existing similar materials

While there are a few sources that contain problems of this nature in a scattered or random manner, there is no single, thoughtful compilation of problems which is broad based and represents a wide variety of applications of school mathematics. Almost every mathematics unit of instruction has some provisions for learning about applications. Unfortunately, many times the problems available have been of poor quality and, therefore, the time devoted to applications has historically been small. This collection of materials is an effort at fulfilling the need to provide high quality application-type mathematics problems.

To the best of the panel's knowledge, there exist no instructional materials of this precise nature. These materials will be unique in that they include problems representing a wide variety of disciplines and everyday life situations.

The likelihood that this product will be used is exceedingly high. This is evidenced by current positions of the NCTM and by reports of significant conferences such as Snowmass and Cape Ann. Probably the most compelling data supporting the teachers' interest in materials on applications are the repeatedly over-subscribed sections devoted to solving problems at professional meetings. Although the Sourcebook is not complete, the NCTM and CUPM have jointly committed themselves to the concept of producing these materials upon their completion. Clearly, there will be no necessity for the use of Foundation funds to support the publishing of these materials following the initial printing of the preliminary edition of 4,500 copies.

Question 3: <u>Do these instructional materials possess a clear purpose and rationale?</u>

The basic assumption of the project is that problems taken from a wide variety of real-life situations are better material for learning the applications of mathematics than problems contrived to illustrate mathematical topics. We infer from looking at the problems themselves that the problems alone can motivate pupils to try to solve them and to learn in the process. We found the portion of the problems available to the panel to be clear and well-written. It is reasonable to expect that these problems will have a positive effect on interested students and will help to raise the level of interest in other students as well. Noting the shortage of problems and other materials specifically designed to develop the skills of <u>modelling</u>, we wonder if the problems themselves were supposed to accomplish that. We are convinced that the full purpose of these materials cannot be realized without careful development of the heuristics of modelling.

We were pleased to learn that teachers will be given a general discussion on how they and their students can create problems themselves, a general statement on "the place of mathematics in modelling" as well as explicit suggestions on how to use the materials in the classroom. We applaud the aim to develop these and other helps but are very much aware of the difficulty of doing so. We urge the development and refinement of this general aim of facilitating teacher use. For example, we feel that attention should be given to making an appropriate index for the many different levels, subject matters, and mathematical ideas covered in the Sourcebook as well as providing organization by types of problems.

The rationale by which the authors are selecting the materials for the Sourcebook is captured in the remark that mathematical thinking at all levels should emphasize that mathematics forms an integral part of our civilization and should equip students in attitude as well as knowledge. This project has a real opportunity to make an important contribution to the education of young people in mathematics and to their confidence in the value of mathematical learning.

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>

That the material is scientifically accurate is guaranteed by the high quality of the Editorial Board. The contents of the problems are also current, but some problem data will eventually become dated.

The goal is to develop a mathematically literate population. As a bonus, some students may also be turned toward a scientific career by demonstrations of the application of mathematics. The problems illustrate most of the mathematical topics taught in grades 7 through 12, except possibly for some pre-calculus ideas that a few students might meet in grade 12.

In summary, we have high hopes for the mathematical values of this material.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

Few adverse reactions are anticipated. However, parents will need to know the reasons behind the use of these materials. The teachers should be especially interested in the use of the source book with students in grades 7-12. Teachers will like the idea of dealing with the reality of these problems. Most students will find the problems interesting and motivating. A comprehensive source does not now exist for these types of materials. It provides for a practical way to gather additional problems.

Teachers should gear the materials to the level of the students whom they are teaching. Indeed, reading the problems could cause frustration for certain students. Although these problems do not typify a unique and new approach, the collection does possess sufficient variety of problems to match the learning styles of most students.

If the project can come up with a practical approach to modelling (as the proposal promises) it will have to be considered ingenious; as it is nearly impossible to find quality material at this level on this important aspect.

The range of students in a typical junior or senior high school to whom these materials might appeal is extremely wide. It is possible that the materials themselves may appeal to a greater degree to goal oriented students. However, the motivation and interest intrinsic in such problems could cause a student to become more goal oriented than before becoming involved in the program.

Many of the problems avoid bias by using the second person pronoun much of the time. These materials are not controversial but may present, as most real problems do, some value problems, e.g., Catherine wants to earn a greater reward for less work; the Williamses are thrifty people; the thief opening a lock, etc. They are adequately handled and in many ways impressive.

These programs should prove to be educationally sound to a very high degree.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

It is intended that students will acquire an increased awareness of the relevance of mathematics to everyday life--the general usefulness of mathematics. Also expected is a heightened interest in problem solving--an analytical responsiveness to problematical situations including specifically (a) developing or selecting a model that represents the situation and permits progress toward a solution and (b) finding solutions to well-formulated problems. When the problem Sourcebook is in use we might expect an increase in the number of entries in national problem solving competitions. We also expect some improvement in the attitudes of most students (whose teachers are using the resource book) concerning the usefulness of mathematics (we don't know how much or how widespread this effect would be). In addition we expect some positive response from those persons who have criticized the mathematics curriculum of schools as being too abstract, e.g., many engineers and natural scientists.

Unless specifically backed up by implementation programs, however, this material will not achieve the expected outcomes for the majority of secondary school mathematics students. There may be no change in students' efforts to use mathematics in daily life unless more attention

is given in the Sourcebook to the modelling process and teachers are helped to understand this process.

We hope that textbook authors will use these problems. But, unless authors of textbooks are strongly encouraged not to organize sets of problems in texts, by method of solution, the tradition that most problems on a given page can be solved by the same algorithm may be expected to continue. If they are used in such a pattern, they will lose their desired effectiveness.

We don't anticipate any unintended effects, and we found no evidence of any biases relating to sex, race, ethnic or religious groups.

We urge an evaluation of student attitudes towards the usefulness of mathematics when their teacher seriously uses this Sourcebook: for example, how much change occurs during a school year in which the Sourcebook was used extensively?

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

No special training would ordinarily be needed to use the materials developed so far. Special training may be needed in terms of helping reluctant math teachers to see the need for the use of the problems. Sometime breaking away from the traditional lesson-to-lesson, chapter-to-chapter approach becomes discomforting to the math teacher. A solutions manual will increase the value of this material. As supplemental material, these materials could and should greatly enhance the teaching of math within the existing organizational structure whatever it may be, and present no problems for the existing organizational structure. From all indications, the costs will be minimal and should, as a result, cause no problems. Everything needed seems to be planned for inclusion and a teacher could purchase the book one day and begin using it the next.

Special optional classes will not be required. The materials are designed to be used by any student in mathematics. We expect that school boards, parents' groups, students, and teachers would judge these materials to be of value. Not only can the problems help in the teaching of math but they also should tend to raise questions and give answers to other facets of life.

There should be no barriers to the implementation of these materials. The only help school districts would need is in proper merchandising of the materials so that the district would become aware of their values.

Question 8: Are the costs for implementing these instructional materials reasonable?

The expected dollar costs for implementing ~~this project~~ should be less than $10 per school or teacher who expects to use the Sourcebook. There should be no costs for continuing use. There are no other ways in which the school districts might spend less money to meet the same need. Mathematics consultants, field trips, and curriculum rewriting would all have price tags considerably higher than using this resource book. Furthermore, no comparable materials exist for this purpose.

As far as non-fiscal "costs" are concerned, some teachers will have a difficult time with some of the problems. It is possible to misuse any materials. For example, a few teachers might use some of these problems as "whips" for disciplinary purposes or in other ways that downgrade pupils.

Our overall reaction is that the material ought to be published and made available and that the cost will be reasonable.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The formal search for problems from a variety of disciplines, as well as the breadth of background of the participants in this project, insure that the materials produced will have the desired diversity. It appears, however, that the internal monitoring procedures have not been adequate to maintain project movement. This project was conceived by several of the best (and busiest) individuals in the field, and there was probably some lack of realism in predicting the level of commitment that these individuals would be able to make to the project. Indeed, this is one case where we feel that the project budget may be too thin in the senior staff category. We would have expected to find at least one FTE staff member, with strong credentials, committed to writing. We had feared, on the basis of the evidence at hand, that the project was not progressing. After a phone conversation with the new principal investigator our concerns are partially eased, but the importance and potential of this project lead us to suggest frequent encouragement (monitoring) by NSF through informal communications with the principal investigator by the program officer in charge.

While the difficulties with the project are due primarily to the internal personnel changes, it is also true that the NSF monitoring was not particularly effective. More frequent contact with project personnel, even on an informal basis, would have kept the Foundation abreast of things. Furthermore, after it became clear that there were personnel problems, there was a surprising lack of initiative shown by the project monitors in encouraging a change to a more efficient or realistic project organization. Future monitoring of this project should include a close watch on the organizational structure.

In summary, we feel adequate information about the progress of this important project has not been coming to NSF and other interested parties.

D. 6. d: SAM (Panel 2): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

NSF Staff Note: Panel 2 chose not to submit individual comments on each project, but rather submitted a response of the whole panel to the 10th question. In addition, one panelist submitted general comments which apply equally to all five curricula reviewed by Panel 2, and which have been agreed to by all other members of the panel.

Panel 2's common response:

We strongly support the concept of this project and our chief concern is that it might founder because it is so highly dependent on the volunteer efforts and general good will of talented and busy people.

We do urge the development of introductory material for teachers, an index, and other helps to facilitate use of the Sourcebook. We think it would be very important to learn whether the introduction of such problems into classroom work by teachers could effect an attitude change in students with regard to the usefulness of mathematics, and how much and how widespread such changes might be. However, in spite of the impressive advances that have been made on this project in the past six months or so (completion of about 50% of the total collection planned) we are still concerned that it be monitored carefully. The project is felt to be of such vital importance that whatever help is needed to keep it from stagnating should be supplied.

General comments prepared by Professor John Allen Easley, Jr., and agreed to by all other members of the panel.

At this point, it is clear that many of the innovative curricula introduced during the 1960s - in particular, many of the "new math" programs - fell far short of the anticipated effectiveness. To insure greater effectiveness in future curricula, each and every new project must be required to look carefully at the shortcomings of the corresponding programs of the 1960s.

There is little evidence that this has been done in the five mathematics projects under review by Panel Number 2 (nor is it being done in most other projects in math and science known to the panel). Instead each project makes its own new guess as to what needs to be done to improve the present situation.

If it is reasonably easy to test such a guess, there is certainly no harm in it. In fact, some of the least expensive projects we reviewed are the most promising. But if the cost of implementing an innovative idea is very large, then we must put forth the strong suggestion that one inquire whether the particular project is worth the cost of implementation. The great difficulty in implementing this suggestion is that the people who are experienced and talented in creating curriculum materials are rarely trained or competent in carrying out such evaluative checks; nor are they, as a rule, sufficiently detached. What is sorely needed in such evaluations is

for those who are inventive in creating new curricula (Usiskin, Pollak, etc.) to be teamed with those who are trained in inquiring into educational programs and institutions.

There are two groups of professional investigators who can help:

1) Responsive evaluators.

2) Cognitive analysts.

At present, the NSF is not supporting this kind of study. As a result, we are facing the danger of a substantial breakdown of communication between the scientific community and the schools. This is reflected in Congress as well as in the lack of enthusiastic reception of many NSF sponsored curriculum projects in schools. To correct this trend, we need not only new surveys of needs but a greater interest of NSF in gaining knowledge about what works and what doesn't work in the introduction of new materials and practices--and why. As we see the projects reviewed by Panel Number 2, a more careful review and evaluation is needed before very large amounts of money are committed to the production of materials. Not only is input needed from a broader range of persons--even the most talented curriculum innovators often overlook certain points of view which are important--but experimental and pilot studies of the innovative ideas should be carefully tested before large sums of money have been committed to materials development.

Experimental trials of carefully revised materials, selected to test the key ideas of the project (perhaps taking only a month or two of school time) to learn teachers' and pupils' perceptions is a kind of research that is much needed. The teaching in these trials must be carefully described and not just results on pupil tests. In addition, both formative and summative kinds of evaluation are needed for curriculum projects. Testing ideas as they come up on a day-to-day, rough draft basis is something that goes on in most projects, but it often needs to be more detached or even more critical than it is. Summative evaluation is needed not only to test whether the intended ideas are learned, but what else was learned that might enhance or detract from what has been taught.

Additional comment by Mr. Daniel J. Hogan:
"I don't agree completely with this statement for the following reason. Although the type of evaluation suggested by Dr. Easley is commendable and should be done, I do not believe that the bureaucracy can stand another outside group. I believe the addition of this kind of expert to the NSF staff would better serve the organization."

D. 7. a: PSIM: NSF Descriptive Information

PROJECT TITLE: Creation, Testing, and Dissemination of Problem Solving Instructional Materials (PSIM)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Richard V. Andree

INSTITUTION: University of Oklahoma

DEPARTMENT: Mathematics

BUDGET: Total Granted: $66,800

Dates: 6/27/75 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Development of enrichment materials for high school mathematics courses.

PROJECT SUMMARY

<u>OBJECTIVES:</u>

The purpose of this project is to develop five independent units of curriculum materials related to cryptarithms and cryptography. The materials will be a source of mathematics enrichment for secondary school students. The potential for use crosses a whole range of high school mathematics courses, as well as independent study, mathematical recreation, and mathematics clubs.

<u>ACTIVITY PLAN:</u>

1. Development of five independent units of curriculum materials related to cryptarithms and cryptography. This will be a major undertaking by a team of experienced mathematical authors and will be tested locally and nationally, and revised before it is released generally.

2. The original units will be tested in a variety of participating Oklahoma schools at various grade and economic levels. The participating teachers will meet in a series of <u>12-Saturday Workshops</u> for evaluation, criticism and suggestions on the material. The students will take a series of pre- and post-tests to determine the extent to which the materials have been able to produce transfer of new logical skills to non-cryptographic situations and any changes in student attitudes toward mathematics and science.

3. The feedback from (2) will be used to assist the authors in revision of the materials and preparation of Instructor's Manuals for the units. When completed copies will be distributed to interested teachers and supervisors through N.C.T.M. and Mu Alpha Theta for additional exposure and feedback.

UTILIZATION PLAN:

A one-week workshop is planned for Summer or December 1976, to help secondary teachers whose schools show interest in teaching units on cryptography and crypt-analysis become familiar with the material.

The revised material will be made available through the National Council of Teachers of Mathematics and/or the National High School and Junior College Mathematics Club, Mu Alpha Theta. The preference of NSF will be the deciding factor in choice of publisher.

PERSONNEL:

Project Director:	Richard V. Andree
Co-Project Director/Writer:	Josephine P. Andree
Editor-Writer:	Claudia Embry
	Mike Andrews

D. 7. b: (PSIM): Project Director's Response to 10 Review Question

Question 1: <u>Is there a genuine need for these instructional materials?</u>

This project is a direct result of expressed needs by secondary teachers in the Oklahoma area. Most mathematics textbooks are written for the average or better student and are strongly dependent on earlier mathematics courses. A student who does not fully comprehend one level is severely handicapped at the next level. One difficulty in teaching students to think carefully and logically is that either the material used requires extensive background, or the logic is so simple (i.e., All men are mortal; Socrates is a man; hence, Socrates is mortal) that it is useless in the solution of most practical problems. Three years ago several secondary teachers challenged me to find interesting problems requiring logical thinking to solve, but requiring little additional mathematical sophistication (no groups, graphs, etc.). The teachers pointed out that many students from deprived homes are woefully deficient in confidence to cope with mathematics and could benefit from additional study of arithmetic facts. However, they are so "turned off", it is difficult to provide effective instruction. A group of teachers brainstormed the problem with Dr. and Mrs. Andree for several weekends before the idea of using cryptarithms and crytography as vehicles for teaching logical thinking was suggested. There is a need for fresh material that will hold the interest of a disenchanted student and offer him an opportunity to succeed. Cryptarithms are challenging puzzles. They entice the student to correlate knowledge of arithmetic and the alphabet to discover a satisfactory solution and test it.

At any meeting of the National Council of Teachers of Mathematics, teachers cluster eagerly around displays of materials presenting new techniques in teaching, often spending their own money for such materials. The wide use (over 25,000 copies sold) of the five booklets of mathematical enrichment materials edited by Mrs. Andree illustrates this point. The National Council of Teachers of Mathematics is aware of the need and has published material on mathematical thinking and logic for secondary students. The Council has expressed interest in distributing booklets from our project when they are available. (See letters at end of proposal.)

The National High School and Junior College Mathematics Club became interested in cryptarithms when Dr. Andree presented a lecture at a national meeting of their students and teachers (The University of Arkansas, 1974). They will publish the project materials. Some will be distributed without charge to their 1400 chapters immediately. Others will be available to any teacher at cost.

Groups of teachers in Arkansas, Oklahoma and California have expressed interest in using these materials with their students. Some visualize cryptarithms as bait for slow learners; some as an extra activity for fast achievers; some as math club projects.

Several collections of cryptarithm problems exist and are evaluated in the assessment of available materials on page 30 of our amended proposal. Brief suggestions for the solution of cryptarithms can be found in books on mathematical recreations. However, these sources do not present understandable discussions of the logic nor theorems to be used in the solution of cryptarithms; let alone attempting to achieve transfer from cryptarithm solving to more general problem solving.

We are devising special problems for the student to solve, demonstrating the application of each method discussed. Problems range from very easy to challenging. Careful examination reveals that much of the literature on cryptography and cryptanalysis is too advanced for secondary use (several excellent papers by J. Levine, for example) while others are trivial (limited to the most elementary substitution ciphers with word divisions left in) and do not stress the logical principles involved. Four books stand out.

> The Code Breakers by David Kahn (1967) is the most detailed (1164 pages) and comprehensive history of cryptography available. It is well written and authoritative. No attempt will be made to repeat this material, but for related historical information, references will be given both to this volume and to Pratt's Secret and Urgent.
>
> Secret Codes by L. Peck (published by N.C.T.M.) contains some excellent, even though very elementary ideas. It is not designed to facilitate transfer of skills to other problem solving situations.
>
> Cryptanalysis by H. F. Gaines (1939, 1956) is completely non-mathematical, but provides an extensive compilation of workable techniques related to solution of The American Cryptogram Association type problems.
>
> Elementary Cryptanalysis by A. Sinkov is the best available text, but is frankly aimed at superior students. It makes no effort to help the student recognize and transfer the statistical and logical reasoning developed in cryptanalysis to the solution of non-cryptographic problems.

Thus, there seem to be no satisfactory alternative materials in this area. The Andrees are convinced that such material can be created. Their combined experience (12 books, 18 booklets, and several hundred expository articles) and willingness to devote their effort to the project suggest they should achieve useful results.

Question 2: Is there a market for these instructional materials?

Most available material on cryptarithms and cryptography is written for devotees, technical army units or other adult specialists. (See more extensive literary analysis in amended proposal.)

This project is creating material on cryptography in simple everyday language, with lots of examples. Examples are worked out step-by-step to instill the logical approach. Many problems of varying difficulty are presented for the student to solve.

Dr. Richard Andree and Josephine Andree have each had 18 years experience in writing mathematics for high school students. They served as editors of the O.U. Mathematics Letter, the Mathematical Log and as book review editor of the American Mathematical Monthly.

Hundreds of teachers have expressed interest in using a mini-course on cryptarithms as enrichment or to create special interest. It will not interfere with the existing curriculum. Today's mathematics programs frequently include "mini-courses" devoted to topics outside the text. Each of the proposed units will stand alone as such a mini-course.

Mu Alpha Theta and National Council of Teachers of Mathematics are enthusiastic about the original presentation of these topics and will support the printing and distribution of the final product. National Science Foundation will not be asked for additional funds for this purpose. Three commercial publishers have also expressed interest in publishing these materials, but the Andrees prefer to make it available at lower user costs through these non-profit organizations.

Question 3: Do these instructional materials possess a clear purpose and rationale?

Hundreds of thousands of students believe they "can't do mathematics." We want to provide such students with a fresh start in a new topic where they can succeed using only the alphabet and simple arithmetic. Previous failure in algebra, geometry or trigonometry would not be a handicap. Cryptography and cryptarithms are not culture-oriented. The logic is the same in Spanish, German, Italian or English.

The simple, conversational tone of the non-technical language catches the interest of the student to "work a puzzle" as a challenging game. Success is the key to further effort. Many very simple cryptarithms are presented with careful step-by-step analysis to develop logical thinking. There are dozens of cryptarithms for the student to solve for himself (herself). Everyone has an equal opportunity regardless of sex, size, strength, color, language facility or lack of social expertise.

There is a matter-of-fact introduction of a simple chart to keep track of observed facts or relationships. This approach can be adapted by the student to many real life problems. A sincere effort is made to achieve this desirable transfer. An entire page is devoted to this task. The student's attention is directed to straightforward relationships he can observe and use for himself, i.e., $1^2=1$, 5^2 ends in 5, 6^2 ends in 6. After being collected in a chapter on theorems these facts are presented as useful information to be used, not as jargon to be "proved."

The project intends to capture the interest of all students in a fresh, challenging topic. We demonstrate logical methods of using observations and making deductions. Presented as a puzzle or game with success available we hope to generate enthusiasm among students who were "turned off" by ordinary mathematics.

Talented students in mathematics clubs have already proved eager to solve cryptarithms and cryptograms. This project presents the material in simple language and less technical style for a wide audience. Mathematics can be and should be fun for both the student and the teacher. The excitement of making new discoveries based on your own observation is catching. A teacher's manual is being prepared for each unit. Teachers will not need special training.

Question 4: Is the content of these instructional materials scientifically correct?

The beauty of cryptography is that the student develops for himself accurate relationships between letters (cryptanalysis) or numbers (cryptarithms). Once a conjecture is made the student tests it for consistency before accepting or rejecting it. Solutions must also be tested to be sure they are the only solution or to find additional solutions. This is good training in the scientific method without cumbersome formal phraseology.

These instructional materials are aimed toward developing the habit of logical thinking and systematic testing of results. This technique of logical analysis is basic to the scientific method. Previous scientific experience is not a prerequisite. The students' ability to make valid deductions based on available data is constantly tested (and rewarded if correct). In most scientific work the time lapse between conjecture and acceptance of the result is frustratingly long. Cryptarithms and cryptanalysis do not suffer from this difficulty. Scientists, mathematicians and just plain John and Jane Doe need training in logical (scientific) deduction. The lack of immediate reinforcement is one reason such training often fails to "take" with weakly motivated students.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

If enthusiastic reception by teachers and students alike is any criterion of educational soundness, the Andrees' material on cryptarithms and cryptography has much in its favor. The reaction to both lectures on cryptarithms given to students from low and mid-income homes surprised even us. Weeks later, our mail contained letters from students who had been working on the cryptarithms handed out for student solution at the end of the lecture. A genuine pride of achievement shone through the atrocious spelling and grammar. It was this reception that persuaded us to set aside other writing projects in favor of the cryptanalysis and cryptography series. We have had no indication of possible unfavorable reactions from anyone.

Experience suggest that bright students are eager to investigate cryptography or any other new challenge presented in an interesting fashion. Special advanced problems, projects and reports are included for such students in each mini-course. However, the most startling and effective use of these materials has been to rekindle interest in students (in our case, from lower economic and minority homes) who had been disheartened by traditional mathematics courses.

The sincere effort each mini-course makes to help the student recognize and achieve transfer of the newly-developed problem solving techniques to non-cryptography areas is particularly noteworthy.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

Although the outward content of these units is the solution of cryptarithms, codes and ciphers, the real impact is apt to be the identification of latent mathematical and scientific ability that has been "turned off" by traditional courses. Once recognized, it may be possible to develop such talent within the framework of the traditional curriculum.

The enthusiastic reception given our advanced experiments, both by supposedly low ability students and by the top (Mu Alpha Theta) students, is encouraging. We recognize that anything new produces a Hawthorne effect, but suspect that more is involved here. We are convinced interest can be generated, then transferred to real life problem solving. Students can be taught to apply the logical methods that must necessarily be used to solve ciphers and cryptarithms to to non-cryptographic problem solving. The material is free of religious, ethnic, social and economic bias as well as being independent of earlier secondary preparation in mathematics or science. One unintended result has been the better understanding of arithmetic

properties by the students. Several commented, "I never did understand how to take square roots until I worked with square root cryptarithms." It is probably too much to hope that similar serendipitous results will be discovered in the area of language combinations when cryptanalysis is studied. A much greater understanding of how statistical data are used to make plausible conjectures for scientific method examination should certainly result. These anticipated outcomes are eminently desirable.

Question 7: Do these materials present implementation problems for the schools?

Each booklet starts with examples of simple, basic techniques and shows the student how to achieve results. No special equipment is required. The student uses arithmetic facts to solve cryptarithms and "letter statistics," including digraph and trigraph frequencies and pattern words to solve cryptograms.

Paper and pencil are the only needed tools. The instructional materials are carefully phrased in simple English to be readily understood. Desirable tables and charts are included in a form that can be economically reproduced, using local equipment if additional charts are desired.

The Instructor's Manual being prepared with the cooperation and suggestions of the 70+ teachers participating in the prepublication experimental evaluation will suggest teaching techniques that have proved effective in presenting this material in addition to philosophical and behavioral objectives for each section of each unit. Suggested hints to use with difficult problems as well as complete solutions will be provided.

The project plans to present materials to teachers in several workshops. Many teachers have already asked to participate. Their suggestions will be incorporated into the final mini-courses and the associated Instructor's Manual. Teachers need not attend a workshop to use these materials once the Instructor's Manuals are available.

The National High School and Junior College Mathematics Club will undertake printing the booklets. Copies will be distributed to their 1500 chapters (28,000 members) in all states; copies will be available at nominal cost to any teacher through Mu Alpha Theta and N.C.T.M.

Each booklet is brief enough to be covered in a few days. It could be an outside activity for a student who has completed regular assignments or it could be an interest-arousing interlude for a student who is hopelessly lost in the regular assignment.

Apparently, no special problems in the incorporation of these materials into existing curricula are envisioned by the 70+ school systems that have asked to participate in the prepublication evaluation of the proposed materials.

The cost of the final publication should be very modest. The master copy is being prepared by a team (Dr. and Mrs. Andree, Mrs. Embry and Mr. Andrews) accustomed to working together and experienced in preparation of materials for low-cost lithoprinted reproduction. The preliminary materials are being run on 8½" x 11" paper to provide room for comments, corrections and suggestions, but the masters from which they are run will be reduced slightly and run on economical 5½" x 8½" pages. This is the most economical size available for lithoprinted work. The masters need not be retyped for final production. Corrections are easily made, and entire sections may be altered or deleted with scissors and paste pot.

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

The total dollar cost to NSF ($66,800) is modest since the Andrees are contributing a good deal of effort and expertise above and beyond that covered by the grant. They really want to do this series of mini-courses and are putting in a lot of effort.

Apparently, the anticipated cost of participating in the prepublication evaluation of these materials (teacher time, travel and reproduction costs) presents no problem to the 70+ school systems that have asked to participate in the program. Cost to schools who adopt the material after publication will be even lower, since the Instructor's Manual should eliminate the need for personal contact with and instruction from the authors.

The implementation and continuing cost to the schools will also be modest. The authors have rejected all royalty rights and the final product will be distributed by the non-profit mathematical organizations, Mu Alpha Theta and the National Council of Teachers of Mathematics.

The refill costs are limited to the local reproduction of a few convenient forms from copy provided in the center pages of each booklet.

As far as we can see, any psychological and social effects will be beneficial rather than "costs" and the anticipated increase in understanding of scientific (logical) thinking is not detrimental to society.

Question 9: Is the management/organization plan adequate for producing these materials?

This project is the response to a challenge from a group of Oklahoma secondary teachers for short teaching units that can be used within the existing curriculum and which will require logical (scientific) thinking, but which would not require scientific or mathematical sophistication on the students' part.

The first attempt was the product of brainstorming sessions with in-service teachers, pre-service teachers and college professors. The next stage was a pre-NSF experimental pair of 90-minute lectures to low income, predominantly minority students. This was followed by a semester-long seminar with a select group of bright students (who are able to overcome weak spots in a presentation and even point out their existence) and a lecture to student-teacher teams at a Mu Alpha Theta national convention in 1974.

We then approached NSF with our proposal. When the proposal was accepted, we turned to the members of The American Cryptogram Association at their national convention and through their journal for suggestions and support. Their enthusiastic response delighted us. We shall be shipping each unit to selected members of ACA for technical criticism as well as input from the 70+ teachers participating in the prepublication evaluation. We have lots of outside support, input, evaluation, criticism and interest.

Dr. and Mrs. Andree are an experienced team of mathematical authors who have worked together on many successful projects during the past 18 years. The University of Oklahoma Office of Grants and Contracts and Business Office monitor the financial matters using the standard state-approved accounting and purchasing procedures.

Since the principal authors are the co-directors of the project, the administrative costs of the projects are very low, but the project is certainly adequately administered. The team of Dr. Andree, Mrs. Andree and Mrs. Embry has been working together successfully for many years and can be counted on to produce useful and interesting manuscripts that will be both functional and in good taste.

D. 7. c: PSIM (Panel 2): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The project's efforts at assessment of existing cryptographic material are exhaustive and authoritative. There are other materials on cryptarithms but nothing with as careful an analysis as this project.

However, we question the project's assessment of the value of these materials to the mathematics community and for general classroom use. It is not clear that there is a need for such an exhaustive project on a subject of such limited appeal. It is more likely that these materials will reach a small proportion of the student population, in particular, math clubs.

Furthermore, we question the degree to which this curricular content will effect a transfer of learning to other logical thinking. There should be pre- and post-testing of students' ability to think logically managed by a group outside the project as a means of insuring credibility.

Question 2: Is there a market for these instructional materials?

In the opinion of the panel this product would have extremely limited appeal to the general population. Cryptarithms require considerable teacher familiarity for effective use and have greater potential as a vehicle for enrichment than for problem-solving instruction.

The panel finds publication information somewhat conflicting. Plans for dissemination are tenuous at best.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The stated goals are:

(1) development of logical thinking and problem solving;

(2) help for math teachers and students. (It is inferred that there may be personal satisfaction from working on problems with no immediate application.)

These instructional materials may well be of value for a limited portion of the student population. However, it is questionable that there will be any transfer of problem solving skills. Success may depend upon an already existing interest and skill in problem solving; furthermore, these materials could be discouraging to many students.

In view of these reservations an external evaluation of the impact of these materials is desirable.

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>

The reputation of the author eliminates doubt about the accuracy of these materials. The coverage of the topics goes as far as most secondary school students can go.

These materials present a very special approach to the general topic of problem analysis and as such aim at only one aspect of scientific literacy; they are not aimed at producing future cryptographers.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

Cryptarithms have been used as instructional aids for years. They are generally sound for the use made of them, i.e., enrichment material for talented, highly motivated students. There is no evidence that logical thinking will be an outcome of the use of these materials; in fact, less talented students may be affected adversely.

Adverse reactions can be expected from teachers in reference to motivation and transfer of learning; parents might react adversely to the use of cryptarithms as an instructional program, but not as enrichment. Favorable reactions would be expected from bright students and math club sponsors.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

The proposed outcomes of the use of cryptarithms are:

(1) improved problem solving ability, and

(2) increased motivation of unmotivated students.

On the basis of transfer studies we do not expect much improvement in general problem solving ability. (To get demonstrable transfer, strategies for problem solving must be taught explicitly.)

We anticipate an increase in the ability to solve cryptarithms and to crack ciphers. But we are concerned:

(1) that an attitude that "math is useless" may be reinforced, and

(2) that some students may get "hooked" on cryptarithms and spend far too much time on them.

Question 7: Do these instructional materials present implementation problems for the schools?

It is not anticipated that cryptarithms would be presented as a course in itself, but rather as a mini-course, math club activity, or unit in an existing course. Teachers who use these materials will have to be trained in its purpose and in solving cryptarithms. Students and parents would need information as to the desired outcomes of these materials.

Question 8: Are the costs for implementing these instructional materials reasonable?

As supplementary material the cost will be reasonable.

Comparable materials on cryptarithms do not exist. Although there are some short publications which contain some of this same kind of material, there is nothing as complete or as thorough.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The opportunity for general input into the conception and development of these materials has been restricted to specialized situations (talks, workshops) wherein the personal presentations of the Andree's might have been predicted to yield favorable response. Assessment has been favorable, though anecdotal. We doubt that input has been solicited from the mathematical or educational communities in a setting that evokes comparison with possible alternative resource development projects.

Administration, internal monitoring and feedback has been adequate for this (essentially) one person project.

The Andree's will undoubtedly produce the materials as proposed. But we find no plan for follow-up on the impact of the materials on students, vis-a-vis the project objectives.

D. 7. d: PSIM (Panel 2): Individual Panelists' Responses to the 10th Review Question: What are your general impressions of the curriculum?

NSF Staff Note: Panel 2 chose not to submit individual comments on each project, but rather submitted a response of the whole panel to the 10th question. In addition, one panelist submitted general comments which apply equally to all five curricula reviewed by Panel 2, and which have been agreed to by all other members of the panel.

Panel 2's common response:

The cryptographic materials produced by this project comprise as exhaustive and authoritat coverage of the topics as could be used by high school students. However, there is serious question about the need for this material, in terms of both its limited appeal and its unproven effectiveness in improving problem solving skills.

This panel recommends that projects which propose to produce materials as extensive, as peripheral, and as idiosyncratic as these should carry more definitive plans for follow-up research to determine whether the goals are met. Moreover, the plans must include the development of materials that make explicit how the project's output fits into an instructional program.

The panel would emphasize that it certainly is appropriate and valuable for NSF to fund, from time to time, such small, innovative, experimental or pilot projects. However, follow-up evaluation is an essential part of such projects and should be included in the project plans.

General comments prepared by Professor John Allen Easley, Jr., and agreed to by all other members of the panel:

At this point, it is clear that many of the innovative curricula introduced during the 1960's - in particular, many of the "new math" programs - fell far short of the anticipated effectiveness. To insure greater effectiveness in future curricula, each and every new project must be required to look carefully at the shortcomings of the corresponding programs of the 1960's.

There is little evidence that this has been done in the five mathematics projects under review by Panel Number 2 (nor is it being done in most other projects in math and science known to the panel). Instead each project makes its own new guess as to what needs to be done to improve the present situation.

If it is reasonably easy to test such a guess, there is certainly no harm in it. In fact, some of the least expensive projects we reviewed are the most promising. But if the cost of implementing an innovative idea is very large, then we must put forth the strong suggestion that one inquire whether the particular project is worth the cost of implementation. The

great difficulty in implementing this suggestion is that the people who are experienced and talented in creating curriculum materials are rarely trained or competent in carrying out such evaluative checks; nor are they, as a rule, sufficiently detached. What is sorely needed in such evaluations is for those who are inventive in creating new curricula (Usiskin, Pollak, etc.) to be teamed with those who are trained in inquiring into educational programs and institutions.

There are two groups of professional investigators who can help:

1) Responsive evaluators.

2) Cognitive analysts.

At present, the NSF is not supporting this kind of study. As a result, we are facing the danger of a substantial breakdown of communication between the scientific community and the schools. This is reflected in Congress as well as in the lack of enthusiastic reception of many NSF sponsored curriculum projects in schools. To correct this trend, we need not only new surveys of needs but a greater interest of NSF in gaining knowledge about what works and what doesn't work in the introduction of new materials and practices--and why. As we see the projects reviewed by Panel Number 2, a more careful review and evaluation is needed before very large amounts of money are committed to the production of materials. Not only is input needed from a broader range of persons--even the most talented curriculum innovators often overlook certain points of view which are important--but experimental and pilot studies of the innovative ideas should be carefully tested before large sums of money have been committed to materials development.

Experimental trials of carefully revised materials, selected to test the key ideas of the project (perhaps taking only a month or two of school time) to learn teachers' and pupils' perceptions is a kind of research that is much needed. The teaching in these trials must be carefully described and not just results on pupil tests. In addition, both formative and summative kinds of evaluation are needed for curriculum projects. Testing ideas as they come up on a day-to-day, rough draft basis is something that goes on in most projects, but it often needs to be more detached or even more critical than it is. Summative evaluation is needed not only to test whether the intended ideas are learned, but what else was learned that might enhance or detract from what has been taught.

Additional comment by Mr. Daniel J. Hogan:
"I don't agree completely with this statement for the following reason. Although the type of evaluation suggested by Dr. Easley is commendable and should be done, I do not believe that the bureaucracy can stand another outside group. I believe the addition of this kind of expert to the NSF staff would better serve the organization."

D. 8. a: MP78: NSF Descriptive Information

PROJECT TITLE: Development of a Mathematics Program for Grades 7 and 8 (MP78)*

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Uri Haber-Schaim .

INSTITUTION: Boston University

DEPARTMENT: Physical Science Group

BUDGET: Total Granted: $591,500

Dates: 4/8/74 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIES: The development of teaching materials for 7th and 8th grade mathematics, with special emphasis on application in the social and biological as well as the physical sciences.

PROJECT SUMMARY

OBJECTIVES:

- To relate mathematics to other fields of study and to daily life.
- To present mathematics on a concrete level and then to generalize and abstract.
- To emphasize the intuitive aspects of mathematics rather than the formal ones.
- To involve the students in active learning, reading, expressing themselves orally in class, and working with manipulatives.
- To develop the students' ability to analyze, dissect, model and solve problems that require more than a quick, one-step solution.
- To teach arithmetical skills in a context that demonstrates their applicability to problem solving in the real world.
- To provide reinforcement of previously acquired skills by having the students apply them throughout the course rather than in single units.

* Also referred to as Boston University Mathematics Project (BUMP)

- To build on the fact that education improves when students enjoy the material.

- To improve the preparation of students for subsequent algebraic and geometric studies.

ACTIVITY PLAN:

During the summer of 1975, the project concentrated on producing new materials for the eighth grade (and the preparation of a pre-post test for the seventh grade). Except for corrections of a few typographical errors, the Pilot Edition of the seventh grade was reprinted in its original form.

The development of eighth grade materials will follow more or less the schedule of the seventh grade material this year. However, the piloting will definitely start at the beginning of the school year and, in some cases, will use the tail end of the seventh grade material which some of the slower classes may not have finished.

It was hoped that most of the current seventh grade pilot teachers will be piloting both seventh and eighth grade materials next year. These teachers will attend a workshop in which the revisions of the seventh grade, as well as the new material for the eighth grade, will be studied. (New pilot teachers for the seventh grade will attend a workshop for seventh grade only.)

UTILIZATION PLAN:

During the next year increased attention will be devoted to the logistics of implementation. This will include the planning for leadership conferences, and the preparation of materials for school boards and supervisors.

There has been a plan approved for the notification of publishers about these materials, a meeting was held, and a proposal received from Prentice-Hall. Prentice-Hall was making their proposal to publish these materials on the basis of the first four chapters and the proven capability of the Project Director in curriculum development.

HISTORY:

In September, 1973, a conference on Junior High School mathematics was held at Cape Ann, Massachusetts, supported by the National Science Foundation and organized by the Physical Science Group, Newton College (the Physical Science Group is now at Boston University). The conference examined what mathematics Junior High School students do and do not know, new emphases in content, mathematics in geography, social science, and biology, teaching strategies and styles, mathematics and language, and teacher training. The participants were a cross-section of education with mathematicians, junior high school teachers and supervisors, social scientists, scientists, and a professor of English making presentations, contributing to discussions, and forming recommendations. The conference led to a proposal to develop new seventh and eighth grade materials that would respond to or alleviate the following six shortcomings of present seventh and eighth grade mathematics programs:

1. Lack of basic skills
2. Lack of quantitive reasoning
3. Lack of ability to decide appropriate operations
4. Content overlap and boredom
5. Unreasonable applications
6. Logic and transfer opportunities missed

The leitmotivs for structuring a new program were:

1. A feel for orders of magnitude
2. Functions and proportion
3. Statistics
4. Three dimensional geometry and symmetry

MP78 was funded for $43,200 in March 1974 to begin work. Subsequently, an additional $244,300 was granted for work on the seventh grade course. The project has produced a pilot version of the seventh grade materials, which has had field trials in Mobile, Alabama; Lakewood, Colorado; Belmont, Lexington, and Marblehead, Massachusetts; Detroit, Michigan; Bellvue and Omaha, Nebraska; Philadelphia and Springfield, Pennsylvania; Peace Dale and Warwick, Rhode Island; Memphis, Tennessee; and McLean, Virginia.

PERSONNEL:

Project Director: Uri Haber-Schaim
Physical Science Group
Boston University

Senior Staff: Judson Cross
Romualdas Skvarcius

Junior Staff: Barbara Hatch
Stephen Snover

ADVISORY COUNCIL:

D. 8. b: MP78: Project Director's Response to 10 Review Questions

It is a pleasure to have the opportunity to provide the National Science Foundation and its panel on Pre-College Curriculum Review with further insight into the rationale behind our specific project, Development of a Mathematics Program for Grades 7 and 8.

Since your charge to the panel states that its evaluation "will play a central role in determining the future policy of the National Science Foundation towards curriculum development", I would like to begin my response to your letters of October 23 and November 11 with some basic thoughts on the role of the NSF in curriculum development.

Prior to the involvement of NSF in curriculum development, the textbook publishing industry was probably the only industry whose major input was provided by people in their spare time. Teachers and professors carried full teaching loads and wrote their texts in the evenings and during vacations. It was unrealistic under such conditions to expect that individual authors of secondary school texts (and perhaps also introductory college texts) would pause and ask themselves searching questions concerning the objectives, the content, and the methodology of their undertakings.

The exceptional author who may have been able to succeed in this task would encounter nearly unsurmountable difficulties in finding a publisher. The whole evaluation process of manuscripts by textbook publishers is geared to looking at manuscripts that deviate only in minor aspects from the norm. In this way the gamble on what is new in a manuscript is counterbalanced by the confidence in the manuscript's overlap with the old. It is not warranted to expect a commercial publisher to make a major investment in a significantly new program even if the author has used the program successfully in his own class. These realities are, in my view, responsible for the stagnation in the development of science and mathematics programs over several decades.

The situation changed dramatically when NSF entered the field of curriculum development. NSF provided the risk capital needed to develop and to pilot distinctly new programs and thereby enabled publishers to commit their resources to large-scale production and dissemination.

Making decisions on a major program in science or mathematics involves defining goals, selecting means, and setting priorities for both. To carry out such a process in a responsible way requires a considerable investment of time by a group of persons who are able to handle the variety of factors that enter into the process. Just to make these decisions (as distinct from carrying them out) requires substantial funds. Therefore, a detailed description of content and hardware cannot reasonably be expected to be part of a curriculum development proposal. The proposal must, of course, state objectives and the strategy for reaching the objectives.

It is difficult to make an exact calculation, but I would not be surprised if on the projects for which I was responsible about half of the grant money was spent on careful preparatory work preceding the drafting of student texts. I believe there is evidence that projects that hurried into the stage of drafting student materials without careful analyses of options and their implications ended up with poorer products. I will go further and suggest that from the point of view of long-range cost effectiveness it would be wise to increase the funding of projects by the amount necessary to organize and edit resource materials in such a way that other persons will be able to benefit from the project's deliberations.

I might point out that this situation is quite similar to that of funding any other pure- or applied-research proposals. A truly imaginative research proposal cannot possibly contain a description of the results, nor can it even provide a guarantee as to the exact methods to be followed. A decision to fund only those proposals that do contain such descriptions would be tantamount to funding mediocre research.

As can be expected, some risk ventures yield better returns than others, and NSF should continue to strive to improve its predictive powers. However, I would like to caution the Foundation against requesting excessive documentation on details before the beginning of the work or against simply trying to minimize the risk element altogether.

With the preceding comments as a background, I shall now address myself to the topics that your panel will itself address, with specific reference to the Boston University Mathematics Project.

Question 1: Is there a genuine need for these instructional materials?

There are three recognizable stages in our assessment of the need for our material. The first stage goes back to the middle 1960's, the period during which the Introductory Physical Science and Physical Science II programs were developed. Our detailed feedback operation and the testing and teacher-training program made it inevitable that we observe at close range the ability of thousands of eighth and ninth graders to calculate and reason quantitatively. The understanding and the use of some simple mathematical ideas that are common in physical as well as in social science, or in plain everyday life, could not be counted on (as examples: volume, difference, ratio, significant digits, translating from language to math and back). These widespread shortcomings of students were independent of whether their schools used "old math" or "new math."

The second stage occurred in September 1973 at the Cape Ann Conference, which brought together a versatile group of persons involved in teaching as well as using mathematics in secondary schools. The conference reenforced our earlier observations and pointed out the general directions that new developments may take.

Now, after being in operation for about one and a half years, after completing the pilot edition of the seventh-grade course, we have administered the pre-test part of a pre-post test and can document in concrete form that the skills and the understandings whose acquisition we wish to affect in our program are indeed missing in our entering student population. I would like to stress that we could not possibly have the last part of the evidence when we wrote the proposal.

The program is designed to reach students on both sides of the center of the ability spectrum. We purposely avoided piloting the program with very bright classes. (In general, it can be said that our pilot classes have second or third level students. These definitions vary, of course, from place to place.)

We recognize a certain level of reading competency. However, the materials are designed to encourage reading since the development of the ability to read mathematics (as an integral part of communicating mathematics) is one of the objectives of the program.

I believe BUMP is unique in its clear intent to treat junior high school mathematics as the quantitative part of the daily language used for describing and reasoning, recognizing the similarities in learning mathematics and in the effective learning of a language. Specifically, in our program:

(1) The students read, write, talk, and listen.

(2) They learn concepts and skills in real contexts rather than <u>in vacuo</u> or with artificial illustrations.

(3) Concepts and skills are arranged according to a hierarchy of range of use. They are reinforced by repeated use in different contexts throughout the two years. This approach is illustrated by the enclosed samples from different parts of the text.

Question 2: <u>Is there a market for these instructional materials?</u>

The project is designed for incoming seventh graders. We have undertaken to have the students at the end of the eighth grade be at least as well prepared for algebra as they would be in any of the existing programs. Thus, there is clearly an existing slot for the program in the curriculum. (However, this fact should not carry much weight in deciding the merit of a proposal. If NSF were to make it a matter of policy to support only curriculum projects for which there is a current slot, it would contribute to freezing the structure of today's curriculum which is already antiquated. It must be recognized, of course, that programs without a slot are harder to implement.)

I do not believe that any project should rely on NSF funding for dissemination at the school level. (I shall come back to this point in conjunction with implementation.) In the case of BUMP, we plan to follow the very successful model that we established with IPS. That is, workshops will be organized and funded by the publisher and the instruction will be directed by the project. The publishing proposal, which was submitted by Prentice-Hall to Boston University following the procedures established by NSF and which we have accepted, specifically states:

> Workshops
>
> Although the length and substance of the workshops cannot be determined this early in the life of the Project, we think the University and the successful bidder should plan on ~~eventually~~ developing a workshop of between 5 and 10 days. The program is unlikely to include many "wet" labs; consequently, the time required to cover the necessary material in the workshop should be substantially shorter than the time required for the IPS workshops. The instructors in every instance should be trained by the University or by persons authorized by the University. In any instance, the workshop instructor should satisfy standards set by both the University and the Publisher.
>
> Such a workshop program will require substantially more funds than a publisher is accustomed to spend for such activities. Thus we propose to set aside 4% of the net receipts of the sale of the student text to finance the payment of the workshop instructors.. We would agree to furnish the printed material for the workshops free-of-charge and provide the manipulatives as a loan. We would ask the school systems that have adopted the program to furnish classroom space for the workshop at no cost. Such a workshop program would be best administered jointly by the Publisher and the University.

The fact that a leading publishing house committed itself to publishing and disseminating the program at a time when only the first three chapters of the pilot edition of the seventh grade were available should speak for itself as far as the likelihood of use is concerned. One has to bear in mind, of course, that the publisher has made the assumption that he will receive packages of student and teacher material that were well thought through from the start and extensively piloted and revised where needed.

Question 3: <u>Do these instructional materials possess a clear purpose and rationale?</u>

This topic seems to me to be covered quite adequately in the proposal and under article 1 of this letter. There is one point on which I wish to take a clear stand, and this is in reference to the so-called "individualized instruction." In common usage this term represents a system of instruction in which, in practice, only the pace is individualized. The units themselves are essentially the same for all students in the class.

We prefer a system in which we individualize the depth of learning, the amount of remedial assistance or extra challenge offered. We accomplish this by providing core materials that encourage discussion, flanked by sections devoted to strengthening weaker students and providing an outlet for the interest of the abler students in the class.

As can be expected, the clarity of our pilot materials varies. This is indicated by the feedback. The two enclosed samples were purposely selected to illustrate one example of a section that went very well (there are many of these) and one example that encountered difficulties everywhere (there are few of these). In many cases the feedback that we receive contains specific suggestions for improvements in the text or for classroom management. The latter are noted by a "G" in the margin for inclusion in the teacher's guide.

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>
and
Question 5: <u>Is the content of these instructional materials educationally sound?</u>

The qualifications of the Project Director, the staff, and the members of the Advisory Council are on record. Should the panel have any questions or comments, I shall be glad to reply to them.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

Can there be any doubt that the goals of our program are more relevant for the vast majority of citizens than are the axiomatics of arithmetic or the distinction between rational and irrational numbers? Is there really any risk of harming a child by developing his ability to read for content (a passage, a map, or an equation) or to visualize the three-dimensional space he inhabits?

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>
and
Question 8: <u>Are the costs of implementing these instructional materials reasonable?</u>

My more than fifteen years of experience with science teachers and, more recently, with mathematics teachers have convinced me that most of them are able and willing to do a better job provided they have the necessary tools, learn how to use them, and get proper administrative support. Unfortunately, with few exceptions, just to provide teachers with a new program is not enough. (I am prepared to show that any new curriculum project in science or mathematics that claims that the successful implementation of its materials will not require any in-service training of teachers is a farce.)

The successful implementation of BUMP will require teacher workshops. We estimate that each year of our two-year program will require a ten-day workshop. Of the ten days, three to four should occur before school starts and the rest during the school year. It should be noted that this projected ten-day workshop can be expected to pose even fewer problems than the 15-day workshop for IPS.

For a school system to be able to make a rational decision on the implementation of the program it must have leaders who have studied the program and are able to serve as workshop instructors. We believe that the training of potential leaders and decision makers (such as professors of math education, math supervisors, and outstanding classroom teachers) deserves the support of NSF. As I stated earlier in this letter, our project will not require federal assistance for implementation at the classroom level.

The printed materials can easily be priced competitively, considering the extravagent printing of some of the new textbooks. The few manipulatives should not be a major concern.

As to "non-fiscal costs", BUMP is an interactive learning experience that stresses various aspects of mathematics computing, estimating, recognizing patterns, etc.) that can be expected to have an encouraging effect on children who have previously had negative experiences in mathematics. (Evidence for this has already been reported to us by the pilot teachers.)

Question 9: Is the management/organization plan adequate for producing these instructional materials?

I think it would be highly improper for the Project Director to comment on the questions related to management. However, under Question 9 the involvement of parents is mentioned. It is in this area that I have added a new dimension to BUMP that was not present, for example, in IPS.

When we plan to visit a pilot school, we notify the school administration in advance and suggest that a meeting with the parents of our students be arranged. Several meetings of this kind took place last year. The attendance varied, from a large to a small representation of parents. However, the meetings succeeded in helping us to ~~determine~~ the concerns of the parents ("Will my child be ready for algebra?") and their delights ("My child enjoys math for the first time."). These meetings will be very valuable for us during the later stages of the project when we shall be ready to prepare some explanatory material for parents and administrators.

Question 10: What are your general impressions of the curriculum?

Since cost effectiveness is justifiably an important concern of NSF and Congress, I would like to urge the Foundation to give serious consideration to making longer-term grants once a project has proved its initial viability. Short-term funding inhibits the recruiting and the retention of first-rate staff members, and there is nothing more wasteful than compromising on the quality of the staff. Therefore, I would urge the Foundation to consider two- to three-year proposals from those projects that warrant support.

Additional Comments:

Evaluation

The major function of the evaluation component of the project is to contribute to the revisions that will be made before the publication of the regular commercial edition. As such, it is a necessarily short-term and highly focused activity. The issues under consideration relate to such questions as:

- Are the units optimally sequenced?
- Are there certain topics that need more or less explanation?
- Is there enough variety in the questions?
- Is there enough remedial and extra-challenge material to meet the needs of a broad spectrum of students?

However, there are many more long-range goals, not directly related to the revision process, that need to be evaluated. Our objective is that the effects of the program will extend beyond the two years that a student is in the program and beyond his or her performance in the mathematics classroom. Specifically, it should be determined whether two years of BUMP will:

(i) enhance the student's willingness and ability to apply mathematics in the natural and the social sciences

(ii) contribute to a greater comprehension of reading materials that contain mathematical representations (e.g., charts and graphs)

To adequately evaluate the degree to which the program accomplishes these goals will require a longitudinal study in which the performance of BUMP students is followed at least through the tenth grade. This task is properly assigned to a qualified outside evaluator, with whom we shall be happy to cooperate. Such cooperation is certain to improve our own test instruments and may also be useful to the evaluator.

Status of Seventh-Grade Material

NOTE: The piloting of the seventh-grade material in the schools started around November 1, 1974, and not at the beginning of the school year because of a delay in starting the work on the project. The faster classes studied parts of Chapter 9 and all of Chapter 10 this year. The slower classes are now working on Chapters 8 and 9.

1. Student Text

Pilot Edition consisting of 10 Chapters - Completed.

2. Feedback

Annotated copy of feedback cut up and organized by section - Through Chapter 7.

Summary of feedback to be used in revision, and preparation of Teacher's Guide - Through Chapter 4.

3. Tests

Pre-post test, 2 parts, 30 questions each. Administered Sept. 1975 to all project seventh-grade students and control groups.

All copies were returned to the project. The test will be administered again in June 1976.

Overall analysis of Pretest results - Completed.

Achievement Test, Chapters 9-10, available and currently in use.

Achievement Test, Chapters 6-8, in preparation.

Status of Eight-Grade Materials

Text: Chapters 1-2 run off for lead classes and to be printed with Chapter 3.

Chapters 3-4 in preparation. Much of the rest of the course has been resourced.

Test: Chapters 1-2 in preparation.

Teacher's Guide: Notes for Chapters 1-2 distributed to pilot teachers.

D. 8. c: MP78 (Panel 2): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The project director's experience with the Introductory Physical Science and Physical Science II programs indicated that there was a need for a mathematics program to improve the calculating and reasoning ability of students based on problems from plain everyday life. The Cape Ann Conference reinforced this observation and served as an impetus for the initiation of the project. Now that this project has had one and a half years of operation there are data to support the contention that these skills are missing in the entering student population.

The continued use of teacher feedback to revise the materials is an indicator of the sensitivity, on an ongoing basis, of the project to the needs of the students.

The need for reorganizing the junior high program is a generally accepted one. The dissatisfaction of teachers with present programs has increased in the past few years. Teachers have been requesting more materials which are relevant to the students everyday life. There is an almost unanimous opinion on the part of mathematics educators of the need to revitalize mathematics education with applications.

It is also generally recognized that many students in school today need improvement in their mathematical reading skills. Nevertheless, mathematics teachers have rarely considered it their responsibility to teach reading. The project has as one of its objectives to increase the ability of students to read mathematics by providing more for them to read than traditional programs.

This project is also trying to be responsive to the generally accepted notion that it is important to have an exciting mathematics program for the 7th and 8th grades and to include substantial new material over that usually covered in grades 1-6. It is also responsive to the need for a program building on a student's everyday experience.

The materials have been written with a sensitivity to the opinions of practicing teachers and are geared to a population with a wide range of abilities. As such they should potentially appeal to the teachers, and thus reach a large number of students. There are many laboratory materials which are intended as supplementary aids to traditional programs. This project uses similar materials as an integral part of the program.

Question 2: Is there a market for these instructional materials?

The objectives of The Boston University Mathematics Program (BUMP) vary substantially from those of other commercially produced and available

curricula for grades 7 and 8. The inclusion of material closely allied to the every day life of the child is of considerable value and much in evidence.

In the opinion of this panel, there is a slot for this product in the junior high school curriculum but it should be noted that the adoption of this program requires the preparation of teachers by pre-service[1] workshops.

The emphasis on applications distinguishes this material in such a way that it should be commercially attractive. Plans for publication by a commercial textbook publisher are especially encouraging since a large portion of the manuscript has yet to be developed.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The stated assumptions of the project are:

Students don't have quantitative skills.

Math is boring. There is a need to build skills in an interesting way.

Students see no relevance in Math problems.

Logical Reasoning develops transfer to other areas.

The goals of the project are to:

Provide for individual ability and interest of students.

Develop skills.

Develop an understanding of orders of magnitude, functions, statistics and 3D perception.

Develop diagnostic tests.

Based on the materials we looked at, we question whether they can reasonably accomplish the stated goals. In their present form the materials require too much pretraining for teachers. Certainly there are alternative assumptions, values and goals that could meet the need of grades 7 and 8.

Given the usual reading ability of 7th graders, we doubt that the sometimes complex language will be understood by the students without substantial embellishment by the teacher. On the other hand, the new materials do constitute a very tightly organized package, and we don't find major omissions.

Question 4: Is the content of these instructional materials scientifically correct?

A. Questions were raised as to whether some of the terminology, particularly for the metric system, is standard.

B. The illustrations and activities are timely. There is, however, a question as to whether a proper balance has been struck among concepts, algorithms, and applications.

C. The materials are aimed toward scientific literacy. However, physics seems overrepresented while the biological and social sciences are somewhat neglected.

D. The materials are intended to prepare students, during grades 7 and 8, for an algebra course in grade 9. However, to actually cover all the topics listed for grade 8, it will not be possible to include the kind and number of activities used in the seventh grade text. But to omit any of the planned topics for grade 8 may well result in inadequate preparation for algebra. In particular, facility in dealing with symbols cannot be slighted.

E. The seventh grade text seems to assume closure for topics studied in the elementary school, in particular decimals. Is this practical? It will be very necessary to evaluate the final product to see whether it does indeed prepare for ninth grade algebra.

In summary, the emphasis on mathematics in the real world is good, but it may have been carried too far, at the expense of concept formation.

Question 5: Is the content of these instructional materials educationally sound?

A. There may be some adverse reaction on the part of staff, teachers, and students. Moreover, some parents and teachers may wonder whether these materials will prepare their children for subsequent courses in algebra and geometry.

B. Psycho-motor problems may exist with junior high students in the manipulation of some of the physical materials connected with certain problems. Because of the variety of activities in these materials, e.g., reading, discussion, laboratory activities, etc., some part of the program should appeal to almost all learning styles and types of students.

C. The approach is appropriate for most students. One plus factor is the supplementary materials for all students regardless of ability.

D. These materials present no evidence of bias or value orientation. Ecological problems are lacking and would help to enhance the program.

E. The objectives of the program are ambitious but worthwhile. Great care should be taken to see to it that these objectives are met inclusively through proper training of teachers.

In summary: the materials appear to be educationally sound. Teachers will need in-service training. Educators must be aware of all objectives and receive training in reading, oral expression, etc. The field testing should give an indication of the soundness of the materials.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The intended effects of this project are aimed at increasing the general competence of students in quantitative reasoning in scientific and other applied fields. Specifically,

(1) to relate mathematics to other fields of study and to daily life;

(2) to involve the students in active learning, reading, expressing themselves orally in class, and working with manipulatives;

(3) to develop the students' ability to analyze, dissect, model and solve problems that require more than a quick, one-step solution;

(4) to improve the preparation of students for subsequent algebraic and geometric studies.

We would expect the materials to lead to an increase in quantitative thinking in physical science areas.

Unintended effects might be:

(1) A feeling that the applications of mathematics are just as esoteric as the mathematical theory itself. There is a short list of precise concepts ("bracketing," "approximation to the nearest ____," etc.) which are undefined, poorly explained, and frequently demanded.

(2) Little improvement in non-physical science applications.

(3) Little improvement in arithmetic; e.g., most junior and senior high school students don't understand decimal fractions.

(4) Little improvement in the preparation of students for algebra; e.g., the ability to handle symbols with confidence, unless the 8th grade text departs significantly from the format of the 7th grade text (e.g., object manipulation).

The materials are free of "undesirable" biases (sex, race, creed, etc.).

The present materials make the learning of precise concepts difficult.

Question 7: Do these instructional materials present implementation problems for the schools?

A. Special teacher training will be needed. Most traditionally trained junior high mathematics teachers will need a reorientation to the purposes and processes of the junior high to use these materials effectively. They will need to learn how to use the BUMP materials as the basic text. They will need to be trained to ask questions that elicit the kind of responses needed by the objective "expressing themselves orally."

B. These materials do not pose problems for the existing organizational structure within the schools to any great extent. They are written to be used in the traditional graded classroom. However, today there is less of a well defined 7th grade "slot" than in previous years.

C. Materials costs appear to be realistic. There will be an in-service training cost.

D. No special resources are required that cannot be easily supplied.

E. The materials will not require school districts to establish optional classes for students who do not want to use this program.

F. Additional comments.

Communities will need to be convinced that these materials are an improvement and are relevant to today's world.

One of the objectives is to involve pupils in reading and expressing themselves orally in class. Examination of the materials does not reveal helps in these areas.

In-service training will be necessary to help teachers in planning to achieve the objective of "analyze, dissect, model and solve problems that require more than a quick, one step solution."

Overall Evaluation:

To implement this program, teachers will need in-service training, and the community will need to be trained to accept the "new math" quality.

Question 8: Are the costs for implementing these instructional materials reasonable?

A. Expected costs for implementing?

Cost for material for use with pupil will be the same as using traditional materials.

An additional cost will be necessary to train teachers. The panel's estimate is about $600 per teacher + $1,000 for a consultant.

An additional cost of enlisting community support will be necessary. It is difficult to put a price tag on this aspect.

B. Continuing costs?

Not any more than traditional programs. New teachers will need some training as they enter the program.

C. Other ways community might spend money to achieve the same results?

Using traditional materials will not require additional expenditure, but may not achieve similar results.

D. Expected costs of comparable instructional materials?

There are no comparable instructional materials.

E. Non-fiscal costs?

The school system that uses this material may have to work at retaining community support. Some groups may question the approach taken by the BUMP materials.

F. Additional Questions?

None relative to costs.

Overall Evaluation:

There will be additional costs to implementation.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

A. The applications prepared in this project lean strongly toward physics and mathematics but are weaker in biological, economic, and decision-making applications. This could have been avoided by a more thorough effort at canvassing professionals in these fields.

B. Internal monitoring of this project took the form of extensive feedback from pilot teachers which were used to gauge the quality of the material produced.

C. There was informal monitoring of this project by PTA groups in the pilot schools. The only documented monitoring of this project consisted of informal discussions in November 1974 and visits by NSF monitors in August 1975. This low level of monitoring is certainly inadequate for a project at the half-million-dollar level.

D. The questions regarding project administration are covered in the discussion provided under F below.

E. It would certainly be desirable to have closer communication between NSF and project principals.

F. Project administration is an appropriate point to bring up for discussion of the general character of the funding of this project. There are two points in question: First, the grant has created[2] an eleven-person operation with a) little check on effective administration and control, b) weak incentive for efficient operation, and c) no provision for measuring the efficiency. Such a setup is very questionable, particularly with a project of this size. It is strongly suggested that, in the future, large grants be required to set up detailed, comprehensive task scheduling and to provide formal, periodic reports as to how effectively resources are being utilized.

Second, the project makes fulltime use of six faculty members[3] at salaries between $17,000 (3) and $32,000 (3) and a total cost to the Foundation of $310,000 for fourteen months.[4] This arrangement ignores the traditional system of academic personnel carrying on both fulltime teaching (supported by the university), and a research project that is regarded as part of their professional life. Such a traditional arrangement would not only reduce the cost of this project (by $100,000 to $200,000), but also provide a better measure of the ~~commitment of~~ the staff to the project. It is strongly suggested that in the future this latter method of funding be used in preference to the wholesale hiring of the professional staff.

Footnotes (comments offered by the Project Director):

1) "pre-service" should be "in-service."
2) The Physical Science Group was at Boston University prior to the receipt of the BUMP grant. Only two research assistants and one research associate were hired specifically for the project.
3) During the period to which this paragraph refers (May 1974 - June 1975), three, not six, faculty members worked on BUMP. The percentages of their time devoted to the project were: Uri Haber-Schaim, 48%; Judson B. Cross, 33%; and Romualdas Skvarcius, 44%. The research assistants and the research associate who were hired on one-year appointments are not members of the faculty.

4) Four of the six salaries were under $17,000 a year. The statement in the text implies that during the 14 months about $170,000 were paid in salaries to these six staff members. The actual expenditure was $82,372. Total cost of the project at that time (end of June 1975) was $243,132 and not $310,000.

D. 8. d: MP78 (Panel 2): Individual Panelists' Responses to 10th Review Question: <u>What are your general impressions of the curriculum?</u>

<u>NSF Staff Note</u>: Panel 2 chose not to submit individual comments on each project, but rather submitted a response of the whole panel to the 10th question. In addition, one panelist submitted general comments which apply equally to all five curricula reviewed by Panel 2, and which ~~have~~ been agreed to by all other members of the panel.

Panel 2's common response:

The goals of this project are worthwhile but ambitious. Whether they can be reached in a mathematics course for only grades seven and eight is not clear. The present BUMP materials leave the Panel quite skeptical. Nevertheless, the Panel is not ready to recommend abandoning the project. However, a more careful evaluation of the feasibility of the BUMP goals is needed.

We recommend that BUMP select a substantial part, about one semester's worth, of their seventh grade course for revision. This segment should be particularly relevant to the BUMP objectives. One possibility could be the topic of "measurement." This material should be carefully revised, taking into account the experience with the pilot use and the comments made by the Panel. Once the revision is completed, it should be evaluated to see how well the BUMP approach achieves its goals, particularly the goal of improving mathematical reading ability. We suggest that the evaluation be done by an outside evaluator, but that the evaluator work closely with the BUMP staff, so that all the BUMP objectives are fairly treated. The outside evaluator is needed to make sure that no other important and relevant mathematical objectives are neglected.

If the evaluation results are positive, then other questions, such as the possibility of a BUMP approach through grades seven and eight providing adequate preparation for ninth grade algebra, would have to be thought through before a decision on further BUMP development could be made.

We recommend that the NSF staff consider very carefully the comments in the Panel's response to Part F of Question 9.

General comments prepared by Professor John Allen Easley, Jr., and agreed to by all other members of the panel.

At this point, it is clear that many of the innovative curricula introduced during the 1960's - in particular, many of the "new math" programs - fell far short of the anticipated effectiveness. To insure greater effectiveness in future curricula, each and every new project must be required to look carefully at the shortcomings of the corresponding programs of the 1960's.

There is little evidence that this has been done in the five mathematics projects under review by Panel Number 2 (nor is it being done in most other projects in math and science known to the panel). Instead each project makes its own new guess as to what needs to be done to improve the present situation.

If it is reasonably easy to test such a guess, there is certainly no harm in it. In fact, some of the least expensive projects we reviewed are the most promising. But if the cost of implementing an innovative idea is very large, then we must put forth the strong suggestion that one inquire whether the particular project is worth the cost of implementation. The great difficulty in implementing this suggestion is that the people who are experienced and talented in creating curriculum materials are rarely trained or competent in carrying out such evaluative checks; nor are they, as a rule, sufficiently detached. What is sorely needed in such evaluations is for those who are inventive in creating new curricula (Usiskin, Pollak, etc.) to be teamed with those who are trained in inquiring into educational programs and institutions.

There are two groups of professional investigators who can help:

1) Responsive evaluators.

2) Cognitive analysts.

At present, the NSF is not supporting this kind of study. As a result, we are facing the danger of a substantial breakdown of communication between the scientific community and the schools. This is reflected in Congress as well as in the lack of enthusiastic reception of many NSF sponsored curriculum projects in schools. To correct this trend, we need not only new surveys of needs but a greater interest of NSF in gaining knowledge about what works and what doesn't work in the introduction of new materials and practices--and why. As we see the projects reviewed by Panel Number 2, a more careful review and evaluation is needed before very large amounts of money are committed to the production of materials. Not only is input needed from a broader range of persons--even the most talented curriculum innovators often overlook certain points of view which are important--but experimental and pilot studies of the innovative ideas should be carefully tested before large sums of money have been committed to materials development.

Experimental trials of carefully revised materials, selected to test the key ideas of the project (perhaps taking only a month or two of school time) to learn teachers' and pupils' perceptions is a kind of research that is much needed. The teaching in these trials must be carefully described and not just results on pupil tests. In addition, both formative and summative kinds of evaluation are needed for curriculum projects. Testing ideas as they come up on a day-to-day, rough draft basis is something that goes on in most projects, but it often needs to be more detached or even more critical than it is. Summative evaluation is needed not only to test whether the intended ideas are learned, but what else was learned that might enhance or detract from what has been taught. 175

Additional comment by Mr. Daniel J. Hogan:
"I don't agree completely with this statement for the following reason. Although the type of evaluation suggested by Dr. Easley is commendable and should be done, I do not believe that the bureaucracy can stand another outside group. I believe the addition of this kind of expert to the NSF staff would better serve the organization."

D. 9. a: MRP: NSF Descriptive Information

PROJECT TITLE: Mathematics Resource Project: Topical Resources for Middle School Mathematics Teachers (MRP)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Dr. Alan Hoffer

INSTITUTION: University of Oregon

DEPARTMENT: Mathematics

BUDGET: Total Granted: $546,800

Dates: 3/15/74 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Development of topical resource books for middle school (Grades 5-8) mathematics teachers.

PROJECT SUMMARY

OBJECTIVES

The Mathematics Resource Project is developing in-service and instructional resource materials from which teachers can select to extend their knowledge and to make more flexible the learning environment for children. These are topical resources intended for middle school mathematics teachers (Grades 5-8). Each resource will contain ideas in the following areas: mathematical content to provide teachers with a deeper understanding of the topic and possible ways to extend and apply the topic; didactics, including suggestions for alternative teaching strategies, techniques for diagnosis and evaluation, and discussion of learning theories; applications and problem solving which give suggestions for student or class projects, including starting points, carry-through and follow-up. These are interwoven into a comprehensive section on classroom materials identified by level of difficulty and including an annotated bibliography.

The proposed topics are:

- Number Sense and Arithmetic Skills
- Measurement and the Metric System
- Mathematical Sentences and Systems
- Geometry
- Relations and Graphs
- Number Patterns and Theory
- Ratio, Proportion and Scaling
- Statistics and Information Organization
- Probability and Expectation
- Mathematics in Science and Society

These resources will be used in several ways. They are primarily intended for use by middle school teachers, but secondary school mathematics teachers could use some of the resources as supplementary materials. Mathematics supervisors and coordinators as well as college and university personnel could use the resources for in-service programs. The resources could also be used as mathematical support materials for people who are interested in comprehensive or interdisciplinary problem solving curricula.

ACTIVITY PLAN

Proposed Project Activities, 1975-76. The immediate priority of the project will be to complete the content and didactics sections of the first two resources. These sections will be combined with the existing portions of the resources (classroom materials, activities, worksheets, commentaries for teachers, and annotated bibliographies) to form the completed resources. Mathematics Education consultants assisting the staff are working on this part of the project through the summer.

The preliminary versions will be evaluated carefully, possibly through the Oregon System for Mathematics Education, as they are utilized in tryout schools in Oregon. Careful attention will be given to developing more comprehensive evaluation efforts during the year.

An Advisory Board will be formed to provide input into both the operation and direction of the project. The project will seek recommendations of the board with regard to efforts of development, evaluation, and implementation.

An entire resource on geometry will be developed as well as several additional units for Mathematics in Science and Society. The first two resources will be revised in April on the basis of tryout and evaluation data obtained earlier in the year.

ORGANIZATION AND MANAGEMENT PLAN

In addition to administering the project, the project director and assistant director will oversee the in-service component of the resources, as well as serve as writer coordinators, providing direction to the writers in the initial planning stage, critiquing the written materials and guiding the materials through production. Writing teams will be formed for the in-service component of the resource: the sections on content and didactics.

The teacher-writers have been school teachers at the middle school level. Their primary responsibilities are the classroom materials of the new resources.

The in-service writers have an extensive background in mathematics and educational theory. They will strengthen the in-service component of the resources: the sections on content and didactics.

UTILIZATION PLAN

Information about the project has been given to Publisher's Weekly and to the Publisher's Alert System of the Office of Education. A presentation of the project for the benefit of publishers was given April 23, 1975 at Denver, Colorado in conjunction with the Annual Meeting of the National Council of Teachers of Mathematics.

Dr. Gary Musser has worked with OMEC to study promising dissemination models to prepare for dissemination of the resources in Oregon. Dr. Ted Nelson will work with OSME to incorporate the resources in the OSME leadership workshop program. It is anticipated that Dr. Musser will coordinate the dissemination activities nationally. These activities will be planned in more detail when the materials are fully developed.

HISTORY

The initial grant was made to the University of Oregon in 1974. The project director, Alan R. Hoffer, and assistant director, Leonard T. Nelson, devoted primary efforts to identifying staff to work on the project, planning for the advisory conference and securing adequate facilities.

An advisory conference was conducted during June 9-12, 1974 in Eugene, Oregon. A report of this conference has been submitted to the National Science Foundation. The project plan to concentrate during the first year on the two resources, Number Sense and Arithmetic Skills and Ratio, Proportion and Scaling, was supported by the participants at the advisory conference, and this has been the main thrust of the work to date. There has also been some progress made on the resource, Mathematics in Science and Society.

The first field testing of the materials was conducted in November 1974. Forty-seven Oregon teachers were identified and invited to test the materials. These teachers taught at different levels, primarily grades five through eight. Some had attended workshops and were involved in OSME activities, while others had no such experience. Of the teachers contacted, thirty supplied the project with information on the sample pages. These thirty now form the nucleus for the first stage of the field testing of the resources.

PERSONNEL

Project Director:	Dr. Alan R. Hoffer Department of Mathematics University of Oregon
Assistant Director:	Dr. Garry Musser Department of Mathematics Oregon State University

ADVISORY BOARD

Dr. Robert Karplus (Science)
University of California at Berkeley

Dr. Stephen Brown (Mathematics Education)
University of New York at Buffalo

Dr. Larry Hatfield (Mathematics Education)
University of Georgia

Mr. Wesley Johnson
Mathematics Supervisor
Seattle Public Schools

Dr. Gene Maier
Oregon Mathematics Education
Council

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D. 9. b: MRP (Panel 2): Project Director's Response to 10 Review Questions

Question 1: Is there a genuine need for these instructional materials?

In 1959 P. H. van Hiele, a Dutch mathematician and educator, reported on a study dealing with levels of mental development in geometry. Van Hiele identified five such levels: in Level 1 the child learns some vocabulary and recognizes a shape as a whole (squares and rectangles are different); in Level 2 the child begins to analyze figures (rectangles have four right angles); in Level 3 the child logically orders figures, understands interrelationships between figures and the role of definitions; in Level 4 the child understands the significance of deduction and the role of postulates, theorems and proof; in Level 5 the child has attained an understanding of rigor and is able to make abstract deductions. Van Hiele showed conclusively that in order for a child to function adequately at an advanced level, it is necessary to master the prior levels. It is no surprise then that students have difficulty in high school geometry (Level 4) when they enter the course at Level 1 after an insufficient elementary school and junior high school experience. It is also not surprising that freshmen who have not mastered arithmetic have difficulty with college algebra or that mathematics majors (even the bright ones) who have not gone through the prerequisite levels have difficulty with abstract algebra.

Readiness is the word. Readiness applies equally well to the teaching of mathematics as it does to the learning of mathematics. The National Advisory Committee on Mathematics Education (NACOME) of the Conference Board of Mathematical Sciences issued a report in November 1975 based on an eighteen-month study. According to the committee's report, the "median" elementary school teacher has taken two mathematics courses and one methods course during pre-service training. These courses did not, however, seem to influence the teacher's teaching behavior--he/she teaches mathematics the way it was learned. Curriculum projects and textbook series for children come and go at a fairly rapid rate. The mainstay in this apparently rapid state of change is the teacher and the NACOME report observes that the number of teachers who are actively using a so-called "new math" program is not as large as once thought. In those classes that were labeled new math, NACOME finds that the performance of the students did not differ much from that of students in traditional classes. I assume members of the reviewing panel are familiar with the results of the National Assessment of Educational Progress (NAEP). The NAEP report clearly shows the performance levels of students of various ages and deficiencies in the teaching-learning of mathematics. If old-fashioned teaching methods are ingrained in today's teachers and if the pre-service courses in mathematics and methods do not substantially influence a teacher's behavior, then no matter how new

the curriculum project or how modern the textbook series, the teacher will not be ready to do the job required. These needs are reflected in the numerous requests for the project materials that we have received. Also, the teachers who have cooperated in the pilot and field testing aspects of the project have requested complete sets of the mate ials. These requests provide us with an ongoing needs assessment for the resource materials.

It must be stated that the goals and purposes of the Mathematics Resource Project were accepted by the National Science Foundation in funding the project. The idea of providing teachers with opportunity for continuing education off campus offers a way to replace the expensive in-service programs of some years ago and widens the audience to include elementary school teachers. Each of the resources offers to these teachers cohesive packages that correlate didactics and mathematical content with suggested classroom activities in a manner meaningful to practicing teachers and helps them account for individual differences of their students. These teachers can use ideas from the resources for <u>all students</u> at grades five through eight.

Question 2: <u>Is there a market for these instructional materials?</u>

While there is a proliferation of commercial companies, the supplementary materials published lack information for teachers on the processes of teaching, on ways to adapt the materials to their students, and on background information. In some cases satisfactory materials were not available. For example, in working on the resource <u>Ratio, Proportion and Scaling</u> we found no decent explanations to teachers about ratios and proportions--concepts that are so useful in the applications of mathematics. Some of the accessible materials were not in a form easily used by teachers. For example, in working on the units <u>Mathematics and Sports</u>, <u>Mathematics and Music</u>, and <u>Mathematics and Pollution</u>, we found that the teacher time required to organize some of these materials would be prohibitive. One of the purposes of the resources is to not only collect and organize some of the available ideas, but also to inform the users <u>where</u> other materials can be obtained and <u>how</u> they can be used.

The resources do not form a curriculum project in the usual sense as a structured program for children. It is more appropriate to view the resources as <u>contributing</u> to a curriculum for in-service teachers In this sense there is not only a slot for the materials but a canyon. There is a large number of schools in the country that have classes for grades 5-8. These schools as well as high school classes in general mathematics form an extensive potential market for the resources.

In April, 1975, a description of the project was presented to a meeting of publishers in conjunction with the annual meeting of the National Council of Teachers of Mathematics in Denver, Colorado. Also, at that time a plan was submitted to the NSF which requested permission to call for proposals to publish the resources. Unfortunately, the Foundation's staff was busy then on internal matters and by the time I received a reply, it was necessary to revise the schedule proposed. With the uncertainties of funding caused by Congressional investigations, a new plan has not been submitted and will likely await the results of the review. I am pleased with the inquiries that have been received by publishers, and I am confident that the resources will become available before long, either commercially or through the NCTM. This is, of course, contingent on NSF approval. Meanwhile, experimental editions of the resources are being disseminated in Oregon through the workshop program of the Oregon Mathematics Education Council (OMEC). Ted Nelson, who served as assistant director of the project last year, is coordinating this dissemination effort as a half-time staff member for OMEC.

As an example of the use of the resources, let me describe an experiment that took place in February, 1975 in Los Angeles when, upon the request for Dr. M. Frodyma, I organized a classroom demonstration fo, directors of NSF projects. I called a supervisor in Los Angeles who gave me the name of a seventh-grade teacher near the meeting site. The teacher reluctantly agreed to put on the demonstration, so I sent her a copy of the pilot edition of the resource Number Sense and Arithmetic Skills. Her class was working on fractions at the time, so she read over the section on fractions and selected four activities for the demonstration. I was informed by the supervisor who attended the demonstration lesson that the teacher is rather traditional and yet adjusted quite easily to these nontextbook materials. In fact, she did not want to part with the sample resource.

Questior 3: Do these instructional materials possess a clear purpose and rationale?

It is assumed that mathematics is an integral part of the educational and cultural formation of children; that teachers are the main source of presenting new ideas to students; that teachers have creative potential; and that they want to improve their understanding of children and mathematics in order to do a better job of teaching. We value a positive self-concept in students and teachers and assume that resources for teachers which organize didactics, mathematics content and suggested classroom activities will help teachers provide positive learning experiences for their students.

It is also assumed that there are a wealth of ideas on learning theories, diagnosis and evaluation, and teaching strategies, in addition to mathematical ideas that should be disseminated to teachers in an organized and cohesive format. As Robert Davis stated in his position paper at the advisory conference, there is a need to assemble materials and results from other sources in order to form a foundation for future work on the mathematics curriculum. By providing teachers with the opportunity to become aware of these materials and to enable them to relate these materials to their students, it is reasonable to expect that the needs identified in Question 1 will be fulfilled to some extent. It is not reasonable to expect, however, that the resources are a panacea for all the problems of teaching mathematics.

The resources, as described in the project proposal, treat all of the mathematical topics covered at the middle school grades. The commentaries for teachers are not condescending but are intended to be practical discussions that form a bridge between the didactics, mathematics and classroom activities. These commentaries, as with all of the resource materials, have been read and reviewed by teachers on the staff as well as by teachers who have field tested the materials.

The choice and sequence of topics to be developed were determined by what teachers requested as well as what we felt would attack the "junior high slump" that was discussed at the advisory conference. The decision to first work on Number Sense and Arithmetic Skills was based in part on the concern by teachers, parents and administrators with basic skills. However, it is our intent to present basic skills in such a way as to promote understanding rather than to teach solely for rote reflexes. We felt it was appropriate to include calculators as a "teaching emphasis" in the resource. The NACOME report also notes the increasing role that calculators play in our complex society. The report goes so far as to say that each child should have access to a calculator for each mathematics class. It is our purpose to use calculators whenever possible to help develop number sense. Ratio, Proportion and Scaling is, we hope, a resource that will provide interest topics for students as well as encourage more thinking in terms of ratios for problem-solving activities. This resource and the units from Mathematics in Science and Society are intended to provide students with possible independent work. It was our original intention to work on two full resources this year: Measurement and Geometry. However, budget and staff reductions forced a cutback. We decided on the Geometry resource because it is our position that geometry should be introduced earlier and receive more emphasis. This is based in part on the works of Piaget, van Hiele and others as well as the "math anxiety" or "math phobia"

groups that have established connections between deficient spatial performances with anxiety in mathematics. Three other units from Mathematics in Science and Society, Mathematics and Astronomy, Mathematics and Biology, and Mathematics and Geography are planned for this year. These topics were chosen because of the expertise of the current staff.

Question 4: Is the content of these instructional materials scientifically correct?

The writing staff on the project consists of two Ph.D.'s in mathematics, one Ph.D. in mathematics education, three classroom teachers and two graduate students. Everything that is written circulates to all members of the staff and eventually is critiqued by pilot teachers. Even though over half of the materials developed were created by project staff members, we have referred to established sources in our researches. An advisory board to the project has recently been composed. This board, when it becomes fully operative, will afford another check on the correctness of the resources.

I have implied by answers to earlier questions that the resources are textbook free. This, I believe, is an accurate statement. Since we have utilized ideas not yet in existing textbooks and we have placed emphasis on such "teaching emphases" as calculators, applications, problem solving, estimation and approximation, and so forth, it seems to me that the resources are not only scientifically current, but they are forward looking and should be useful to teachers who use the next wave of textbook adoptions.

As I stated in the response to Question 3, the ten resources cover all the basic topics in mathematics curricula at the middle-school level. However, for easy reference, the resources are organized topically rather than linearly or by grade. The level of difficulty on student pages is flagged by E (enrichment), S (skill building) or I (introductory). Hence, at each of the grade levels teachers can select activities depending on the performance levels of their students. Particularly able students might continually work at the E level or with units in Mathematics in Science and Society. Students who have not attained a high performance and understanding would likely work at the S or I levels.

Question 5: Is the content of these instructional materials educationally sound?

At the outset of the project in June, 1974, we conducted an advisory conference which was attended by teachers, supervisors, mathematicians, educators and scientists. Copies of the report of this conference are on file at the Foundation. The review panel will see from the recommendations of the advisory conference that the project plan as delineated in the original proposal was to be followed with minor modifications. We have followed the modified plan since the summer of 1974.

During the first year of the project we searched for a way to effectively handle the didactics component of the project. We simply did not make the progress in this area that I had hoped for. Just prior to re-engaging the project this fall we held a didactics seminar and invited six mathematics educators to work for a week in Eugene. Information about this seminar has been made available to our program manager, Dr. Joseph Payne. The result of the seminar was to provide the project with definite direction on the overall didactics component of the project. We are very fortunate to have Dr. Larry Sowder working with us this year to carry the main responsibility for organizing the ideas on didactics. I feel ~~that~~ we can now move forward more rapidly in this area.

In addition to the staff's circulating of all written material, subsections of the resources are pilot tested early in the year by teachers in nearly thirty schools in Oregon. As part of the project evaluation plan recommended by Dr. Alan Osborne, experimental editions of the resources are field tested by over twenty teachers. Based on the results of these field test, the resources are revised into a preliminary form for publication. I believe this is a reasonable plan to insure the educational validity of the resources.

Teachers who use the resources are able to extend their background in a very practical situation. They have available to them exemplary classroom materials which enable them to immediately put into practice the ideas they have learned in the commentaries.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

If indeed the resources are used as anticipated, students will more thoroughly learn mathematics. Some of these students will become teachers who, hopefully, will have gained a new sensibility. If indeed the middle school period is a place where students slump, then the enrichment activities and the applications may be outlets for their energies. The teaching emphases in the resources should be particularly valuable to teachers as a way to bring into focus important processes that are not restricted by particular topics. Calling attention to problem solving, estimation and approximation, applications, calculators, visual perception, graphic representation and the like should make teachers more aware of the fabrics of their teaching. The background information for teachers and the suggested classroom materials should help teachers enrich their teaching practices. Hopefully, school districts, especially in isolated areas, will recognize in the resources the excellent potential to help with the in-service training and updating of their teachers.

Question 7: Do these instructional materials present implementation problems for the schools?

It was mentioned in a response to an earlier question that a pilot version of a resource was mailed to a teacher in Los Angeles who, with no advance training, conducted a classroom demonstration using the resource materials. This is a distinct potential for the resources, since they are flexible and adaptable to different teaching demands. On the other hand, more rapid and possibly more effective implementation of the resources could be achieved through interaction with a workshop leader who could very well be another teacher.

It is difficult to estimate now the cost of a resource when they become available commercially. The resources in their present form have more classroom pages than will appear in the revised edition. A final trimming process will occur during revision as a result of the field testing. Also, the number of copies that we printed was only slightly more than needed to cover the field tests and provide copies to the staff, advisory board members, and the NSF. A commercial publisher or the NCTM should be able to print enough copies to make the costs rather low. Indeed, if the total collection of ten resources cost $300, this would be well within the instructional materials budget of a school and a cheap way to provide a portable resource center and in-service kit.

Question 8: Are the costs for implementing these instructional materials reasonable?

Other than the base cost of the resources, it is expected that schools would have available a thermofax machine and the necessary ditto equipment and supplies. These items are found in most schools.

Teachers who have their own copy of a resource could use the organization of the resource and add to it new ideas that they discover in their teaching. Again, the materials and supplies budget of the school would likely cover these expenses.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The advisory conference was attended by a diverse group of very qualified people. Participants at the didactics seminar brought to the project the most up-to-date knowledge of mathematics education in the country today. Dr. Alan Osborne, in helping us design an evaluation plan, provided the project with an outsider's appraisal of the project operation, the resources themselves, and an objective way to prepare for revision and future evaluation and dissemination efforts.

Internally, the project staff consists of a very hard working group of people who interact well together and blend classroom teaching experience with knowledge of mathematics and educational theory. The quality of the production on both the pilot and field test versions of the resources is very close to that which can be produced commercially and which permits effective use of the resources now.

I am only assigned to the project half-time this year. This was caused by demands made upon me by the Department of Mathematics at the University. As the year unfolds, we will see if this was a wise decision. Meanwhile, I have had help on a part-time basis from Dr. Gary Musser, Oregon State University, to help on evaluation and from Shirley Ann Hoffer, Mathematics Resource Center, to help on production.

I must add that it does take time to break in a writing staff. Much of the summer of 1974 was spent in false starts, but now Richard Brannan, Sue McGraw and Pat Tuel form a writing team of teachers as good as one could hope for. As graduate students, Janet Brougher and Jill Hermanson have made very deep and lasting contributions to the project. Reflecting back on it now, I realize that it took nearly six months to fully develop a production scheme which is now able to handle the various aspects of the project.

Question 10: <u>What are your general impressions of the curriculum?</u>

I am excited with the reception the project has received so far. The pilot testers have been enthusiastic and field testers have volunteered to fill out evaluation pages for hundreds of items in the resources. We have been invited to present the project at numerous meetings of teachers, and we have a long list of people who have requested information about the availability of the resources. I am hopeful that the resources will help teachers help their students learn and enjoy mathematics in addition to being ready for the next level.

D. 9. c: MRP (Panel 2): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

No research or no study was done to estimate the need for these materials. There was an assumption that teachers needed the materials, and that they would use them. There was a further assumption that the teachers who do not avail themselves of in-service training would be likely to use these materials. This may not be so.

Teachers who are not "textbook" oriented and those who make liberal use of supplementary materials would make frequent use of this encyclopedia of activities. Math labs have become very popular and this project's materials would serve as a resource book for such activity. The degree to which the materials would reach students would depend on the attitude of the teacher toward the use of supplementary materials.

In the past few years the popularity of workshops at NCTM meetings has risen dramatically. Teachers fight to get into workshops where they can either make or obtain materials to take back to the classroom. The project's books can be a rich source of many of the materials similar to those found in such workshops.

Much of this material can be found in many other places, but there does not seem to be any large collection in one place. The strength of this project lies in the fact that this collection of alternate instruction materials at this level is unique.

There are elaborate plans for the evaluation of the materials including field tests, teacher feedback, use in in-service programs, and validity determination by an external consultant who has made a study of the teacher preferences in in-service work. There has been no indication of a survey to determine the degree to which these materials would be utilized by classroom teachers.

Question 2: Is there a market for these instructional materials?

There are other sources available which provide reference materials for teachers of grades 5-8. However, the project constitutes probably the most inclusive set of materials of this type together with a pedagogical commentary.

This project in no way requires the alteration of the basic middle school curriculum for its incorporation. It is designed to provide the teacher with additional alternatives for his/her use in providing instruction in many of the standard content areas.

The presentation of the project for the benefit of commercial publishers at an NCTM sponsored meeting is commended. It is premature to expect complete plans for dissemination at this time.

It is quite probable that this set of resource volumes would be a welcomed addition to a resource learning center. However, it is questionable whether these volumes would be purchased by individual teachers for use because of the cost.

Question 3: <u>Do these instructional materials possess a clear purpose and rationale?</u>

A. The following assumptions are made by the program authors.

Teachers are extremely busy with duties other than teaching math.

Some middle school teachers have backgrounds weak in mathematics and need material to help them.

General mathematics is more important than focus on training of college-bound students.

Flexibility--teacher should decide what, when.

Mathematics is useful--not just for tests.

B. Assumptions derived from inspecting the materials are:

Mathematics should be interesting, true-to-life.

Multiple embodiments of each idea are necessary.

Operations should be taught in relation to each other--especially inverse operations.

Helps should be provided to make it convenient for teachers to use.

C. It is reasonable to expect that instructional materials based on these assumptions, values, and goals will fill the needs.

D. The materials are clear and understandable. With regard to cohesive packaging, they form a well-organized, indexed catalog. The sequence is clearly flexible.

E. The project has lessons for teachers on teaching and the teacher is making the selection. It would seem to work best with individual packets for each pupil. The interest and current understandings of the pupil, as perceived by the teacher, are the bases for selecting individual modules.

F. The use of many manipulative materials was intended and they have been identified. Who is going to do an external evaluation of the project's success?

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>

The material for students seems to be accurate. However, the terminology[2] of the metric system does not appear to be standard.

Some of the pedagogical material is open to question. The activities and pedagogical procedures are quite eclectic, perhaps too much so. They are too inclusive and could be used to elicit unreal responses in general math programs. In addition, the two page discussion of the teaching concepts is not in accord with the research findings of the Wisconsin Research and Development Center.[3]

The materials for students seem to be scientifically current, and are designed to train a scientifically literate population. The series will cover all the mathematical topics dealt with in grades 5 through 8.

The question arises as to whether the Advisory Board is able to provide enough guidance, especially in the area of pedagogical procedures.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

A. There should be no adverse reaction on the part of teachers. The teachers will especially like the comprehensiveness of the program. Students will enjoy the activity oriented program as opposed to a typical junior high mathematics program. Parents may have some reservations in terms of traditional math preparation for the future study of mathematics.

B. The content/approach, viz., laboratory activities could present some psycho-motor difficulties for some students. Properly handled there should be few cognitive or affective difficulties. The materials and teacher preparation should give a much needed stress on success experiences and student growth in self concept.

C. The teacher may pick and choose exercises to accomplish the objectives he or she has written and may also receive help from the author's objectives. The materials do not suggest a specific approach. They are not an approach to teaching.

D. The strategies used in the materials are success oriented which in itself is a value even though a desirable one and well done.

E. Ample provisions are made for teacher testing and the feedback will be a measure for educational soundness.

These materials are educationally sound and, in fact many have been used over the years and proven effective.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

What are the intended effects?

(1) Enjoying school mathematics more.

(2) Understanding calculation better.

(3) Increased skills in arithmetic.

What effects do we anticipate?

(1) Enjoying school mathematics more.

(2) Understanding calculation better.

(3) Increased skills in arithmetic.

Thinking of mathematics while filling in the blanks is an important process feature of these instructional materials. Thus an additional effect is possibly an attitude on the part of students that mathematics is just a process of filling in blanks. Students sometimes become so involved in "finding the pattern" in answering each worksheet that they miss the mathematical ideas behind them. Sometimes serious misconceptions of the mathematical ideas result from the worksheet approach. Tests have to go beyond the routine in order to get at misconceptions.

Some review of the content and approach concerning limited bias is called for. See the "Beauty Contest" in connection with the Golden Ratio.

Question 7: Do these instructional materials present implementation problems for the schools?

A. Is special training needed by teachers?

Yes. An in-service program designed to achieve the following goals will be necessary.

- Teachers need to become knowledgeable about using these materials.

- Teachers need to know how to relate these materials to their ongoing program.

B. Do these materials pose problems for the existing organizational structure within the schools?

Yes. These materials may replace traditional materials in the classroom. This may or may not be an advantage. Using these materials may allow a certain amount of individualization not allowed by traditional materials. Some teachers may react adversely to using these materials.

C. Are the costs of the materials realistic?

It is impossible to assay the cost per pupil due to the variety of ways the materials may be used. Publishing them as resource material for teacher use could be done at reasonable cost. Duplication for pupil use via Thermo-Fax ditto masters and ditto sheets makes the use of this resource expensive.

D. Do the instructional materials require special learning resources?

Yes, some lessons require unusual manipulative materials.

E. Will the use of the materials require special classes?

No.

Additional comments:

1. The materials can be used in a variety of situations.

2. There is need for in-service training but this is not an insurmountable task.

3. There are commercially prepared materials of a similar nature. None are as complete or as comprehensive as these.

4. The directions to teachers and the suggestions for the use of the materials should accompany the materials.

Question 8: Are the costs for implementing these instructional materials reasonable?

A. Total costs for implementing:

The use of Thermo-Fax or ditto machine for duplication is an expensive process. When compared with commercial textbook pages or workbook pages, the cost becomes high. In-service training costs will be necessary.

B. Continuing costs:

The material will not need to be repurchased but the duplication cost is still a necessary consideration for continuing use.

C. Other ways school districts might spend money to achieve the objectives of the program:

There are many commercially prepared materials available. None are as complete or contain the suggestions for use that these make available to teachers.

D. Expected costs of comparable materials:

Completely comparable materials are not available, hence this question cannot be answered.

E. Non-fiscal costs:

None.

F. Additional questions:

Is it possible to purchase parts of the material?

G. Overall view of costs:

Implementation may be more expensive than need be. Duplication and distribution problems could be changed effecting a more economical usage.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

A. There has been ample opportunity for input to the project through its awareness efforts, its close association with OSME, and through its advisory council. There is little evidence, however, that the project adequately taps the economic and biological science communities--perhaps essential for a resources development project of this kind.

B. This is a large project, with approximately 12 FTE[4] and staff members, including 6 full-time writers, in addition to 2 half-time directors. As such we would expect to find more explicit managerial practices in effect that would make it possible to determine whether the staff is competent and productive. We find that we cannot answer such questions on the basis of the budget, vitae presented, or existing reports. In fact we have some questions about the appropriateness of salary levels. We deduce from the level and quality

of output to date that the project is proceeding well. We merely feel that when projects reach this magnitude, $1/5 million per year in salaries and wages, that the normal institutional auditing and budget control should be supplemented by reports that permit more detailed monitoring of the effort of the staff and the level of preparation of the staff.

C. The project proposed is quite explicit in its concern for feedback and evaluation. Subsequent followup research will be important but is not part of the project. Certainly, in this case, NSF has monitored progress carefully.

D. The project staff, through its director, has done a fine job in keeping NSF informed of its progress.

Additional comments by Project Director:

1) "The program authors absolutely deny that they assume that 'General mathematics is more important than focus on training of college-bound students'."
2) "Terminology follows the recommendations of the Interstate Consortium on Metric Education, Final Report, 1975, and the U.S. Department of Commerce/National Bureau of Standard Guidelines, November 1974."
3) "The nine-page section Teaching of Concepts is consistent with the book Conceptual Learning and Development, Academic Press, New York, 1974 by Klausmeier, Ghatala and Frazer who were affiliated with the Wisconsin R & D Center."
4) "Change 12 FTE to 7 FTE."

D. 9. d: MRP (Panel 2): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

NSF Staff Note: Panel 2 chose not to submit individual comments on each project, but rather submitted a response of the whole panel to the 10th question. In addition, one panelist submitted general comments which apply equally to all five curricula reviewed by Panel 2, and which have been agreed to by all other members of the panel.

Panel 2's common response:

The Mathematics Resource Project: Topical Resources for Middle School Mathematics Teachers has produced many resources for teachers to use. There are many types of material present. They cover many topics and should become a resource which teachers may find useful. The purpose is to provide a teacher with a readily available source of instructional materials, a variety of ideas about teaching a topic, and information about the mathematical content of a particular topic.

The project is producing materials, they are being tried out by teachers, and they can be made available to others.

There are concerns: (1) the marketability of the finished product. Can it be produced at a price which will make it affordable by school systems and teachers? (2) the cost of its use. Duplication by a thermofax ditto master and ditto duplication is an expensive process when compared to the use of a textbook page. Are there alternative methods which might be more economical? (3) possible misuse as the totality of mathematics instruction. Because of its encyclopedic character, will it reduce teachers to managers of the retrieval, duplication and dissemination of pages and pupils to the fillers in of blanks, with resulting failure to grasp the nature of mathematics? (4) considerations for the inclusion or exclusion of material, topics, or lesson content. Do some of the lessons convey messages not intended, produce cultural bias, or violate the sense of fairness to all groups? The panel also expresses a concern that teachers not use this material in place of a planned, sequential, developmental program. The materials are supplements and are not a curriculum to be followed.

This panel is in favor of the spirit of this project and endorses the idea of a set of topical resources being available to teachers. We do suggest a study aimed at finding the most economical way of packaging and of using the resource.

The panel also suggests that the two completed volumes be refined, used in the classroom, and evaluated as to their effect on student achievement before further materials are produced. This evaluation should be made by an outside evaluator.

Finally the panel recommends that when projects reach the magnitude of this one, the normal institutional auditing and budget control should be supplemented by reports that insure effective management.

General comments prepared by Professor John Allen Easley, Jr., and agreed to by all other members of the panel.

At this point, it is clear that many of the innovative curricula introduced during the 1960's - in particular, many of the "new math" programs - fell far short of the anticipated effectiveness. To insure greater effectiveness in future curricula, each and every new project must be required to look carefully at the shortcomings of the corresponding programs of the 1960's.

There is little evidence that this has been done in the five mathematics projects under review by Panel Number 2 (nor is it being done in most other projects in math and science known to the panel). Instead each project makes its own new guess as to what needs to be done to improve the present situation.

If it is reasonably easy to test such a guess, there is certainly no harm in it. In fact, some of the least expensive projects we reviewed are the most promising. But if the cost of implementing an innovative idea is very large, then we must put forth the strong suggestion that one inquire whether the particular project is worth the cost of implementation. The great difficulty in implementing this suggestion is that the people who are experienced and talented in creating curriculum materials are rarely trained or competent in carrying out such evaluative checks; nor are they, as a rule, sufficiently detached. What is sorely needed in such evaluations is for those who are inventive in creating new curricula (Usiskin, Pollak, etc.) to be teamed with those who are trained in inquiring into educational programs and institutions.

There are two groups of professional investigators who can help:

1) Responsive evaluators.

2) Cognitive analysts.

At present, the NSF is not supporting this kind of study. As a result, we are facing the danger of a substantial breakdown of communication between the scientific community and the schools. This is reflected in Congress as well as in the lack of enthusiastic reception of many NSF sponsored curriculum projects in schools. To correct this trend, we need not only new surveys of needs but a greater interest of NSF in gaining knowledge about what works and what doesn't work in the introduction of new materials and practices--and why. As we see the projects reviewed by Panel Number 2, a more careful review and evaluation is needed before very large amounts of money are committed to the production of materials. Not only is input needed from a broader range of persons--even the most talented curriculum innovators often overlook certain points of view which are important--but experimental and pilot studies of the innovative ideas should be carefully tested before large sums of money have been committed to materials development.

Experimental trials of carefully revised materials, selected to test the key ideas of the project (perhaps taking only a month or two of school time) to learn teachers' and pupils' perceptions is a kind of research that is much needed. The teaching in these trials must be carefully described and not just results on pupil tests. In addition, both formative and summative kinds of evaluation are needed for curriculum projects. Testing ideas as they come up on a day-to-day, rough draft basis is something that goes on in most projects, but it often needs to be more detached or even more critical than it is. Summative evaluation is needed not only to test whether the intended ideas are learned, but what else was learned that might enhance or detract from what has been taught.

Additional comment by Mr. Daniel J. Hogan:
"I don't agree completely with this statement for the following reason. Although the type of evaluation suggested by Dr. Easley is commendable and should be done, I do not believe that the bureaucracy can stand another outside group. I believe the addition of this kind of expert to the NSF staff would better serve the organization."

D. 10. a: FYA: NSF Descriptive Information

PROJECT TITLE: First-Year Algebra via Applications Development Project (FYA)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Zalman P. Usiskin

INSTITUTION: The University of Chicago

DEPARTMENT: Graduate School of Education

BUDGET: Total Granted: $85,310

Dates: 5/1/74 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: The development of an alternative first-year algebra course intended for average students and focusing heavily on applications of mathematics.

PROJECT SUMMARY

OBJECTIVES

There are three motivations for this project: (1) the importance of applications of mathematics to both the decision-maker and average citizen; (2) the first-year algebra course as a natural place where such applications ought to be discussed; and (3) the lack of existing first-year algebra texts for average students which significantly emphasize meaningful applications and related concepts.

The goal of this project is to develop a first-year algebra course which (1) offers a picture of the wide range of applications of mathematics, from which algebraic symbolism develops naturally, (2) covers the standard skills associated with first-year algebra with only complicated factoring and fractional expression problems deleted, (3) devotes some time particularly to fundamental ideas from statistics and probability, (4) is no more difficult than standard courses. The intended student population consists of average to below-average students (from approximately the 30th to the 85th percentile of ability) who now take one or two years to complete the first-year algebra course.

ACTIVITY PLAN

Summer 1975: The pilot edition was revised and reproduced in a form for use in other classes.

School Year 1975-76: The second draft is being tested in three different schools in a total of five classes. A booklet of algebra skills aimed toward mastery learning is being developed and tried out.

Summer 1976: The test results and information from teachers will be used to prepare a third draft.

School Year 1976-77: A carefully controlled experiment on a wider scale is planned.

ORGANIZATION AND MANAGEMENT PLAN

The project director writes all the text materials. A research associate is writing the skills booklet. The project director teaches one class himself and directs the try-outs in the other classes. Informal advisors to the project read and react to manuscripts, give advice on content to be included, and are advising on the controlled experiment planned for 1976-77.

UTILIZATION PLAN

The implementation strategy began in the Summer of 1975. The project director taught a 3-week workshop entitled "Applications of Mathematics - Algebra" in which the participants (both pre- and in-service teachers) were introduced to the materials of this project. The hope is to design a course for in-service training of teachers which could be duplicated elsewhere.

During the school year 1975-76, publishers will be notified that a revised draft of these materials is available. A testing version of the materials is planned for the school year 1976-77.

HISTORY

Summer 1974: The director taught a workshop for teachers entitled "Applications of Mathematics." This workshop was heavily directed to applications for first-year algebra. The first few weeks of the proposed 9th grade course was written.

School Year 1974-75: A pilot edition was prepared and taught in an average secondary school setting. The criteria for selection of this school were geographic accessibility, existence of a capable collaborating teacher, stability of the school situation, degree of support from the school faculty - particularly the administration and mathematics faculty, and the willingness to participate with the strategy as described here.

PERSONNEL

Dr. Zalman Usiskin, Project Director
Associate Professor of Education
The University of Chicago

Informal Advisors:

Dr. William Kruskal, Statistics	University of Chicago
Dr. Izaak Wirszup, Mathematics	University of Chicago
Dr. Paul Meier, Statistics	University of Chicago
Dr. Max Bell, Mathematics Education	University of Chicago
Ms. Pamela Ames, Teacher	University of Chicago
Dr. James Schultz	Ohio State University
Dr. Jane Swafford	Northern Michigan University
Dr. Lauren Woodby	Michigan State University

D. 10. b: FYA (Panel 2): Project Director's Response to 10 Review Questions

Question 1: <u>Is there a genuine need for these instructional materials?</u>

The primary motivation for this project was the need for first-year algebra materials which gave strong attention to applications. The factors which contribute to this need include:

A. the importance of applications of mathematics to both the decision-maker and the average citizen.

   This importance has been detailed by mathematics educators of various backgrounds and opinions (e.g., Henry Pollak, Max Bell, Morris Kline).

   Of all the mathematics encountered by the average citizen, perhaps the most common (outside of simple arithmetic) involve statistics - the need to interpret data.

B. the first-year algebra course as a natural place where such applications should be discussed.

   More students take this course than any other high school course; for many it is their last mathematics course.

   The continued presence of the curriculum of outdated and unrealistic "word problems" serves only to convince the student that there are few if any accessible applications of mathematics, this despite the ever-increasing number of fields in which mathematics is used if not required.

C. the lack of existing first-year algebra texts for average students which significantly emphasize meaningful applications and related concepts.

   No commercially available text for this course gives more than lip-service to statistics and none offers more than a small sprinkle of applications.

More generally, the range of alternatives to a high school wishing to select a first-year algebra text for average students encompasses only rigor and reading level. Given that enrollments in high school mathematics courses (particularly later ones) are generally declining at the same time that college requirements in mathematics in many fields are increasing, there is a general need for the development and testing of variety of alternative courses.

Question 2: Is there a market for these instructional materials?

No one can predict markets with certainty. The project director has had previous experience with an innovative geometry text utilizing transformations and bases his guesses on that experience. He feels that there is a substantial market for the materials because of the following factors.

A. There is a clear need for the materials, as indicated in the answer to Question 1.

B. There is great interest in these materials at conferences. This interest parallels rather closely the interest in transformations when the director was first talking about them in 1968-70.

C. There does not seem to be controversy about the need for applications.

D. The first-year algebra course comprises the largest market for high school mathematics textbooks. These materials are designed for the majority (at least 3/4) of students who presently take that course.

E. The author of the materials is well-known and his texts are used nationwide.

F. There are no competing materials presently available.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The goals of the materials are: (1) to offer the student a picture of the wide range of applications of mathematics, from which algebraic symbolism develops out of natural needs; (2) to cover the standard skills associated with the first-year algebra course with two notable exceptions: contrived verbal problems (replaced by more realistic applications) and complicated factoring and fractional expression problems (unless they are needed for applications); (3) to develop the algebraic properties associated with standard skills by means of applications; (4) to work arithmetic skills and concepts in the natural framework of the course; and (5) to include fundamental ideas from probability and statistics.

It is the opinion of the director that most mathematics teachers would understand each of these goals. However, most teachers would not be able to predict how the materials try to achieve the goals.

To reach goal (1), the author found it necessary to classify the very large number of applications of numbers and the fundamental arithmetic operations. These classifications are based upon extractions of commonalities among many applications of the same type and may constitute one of the most important outgrowths of the materials, for they provide a schema by which a teacher can get a handle on the vast supply of applications. The schema is based upon uses of numbers and models for operations and is summarized in the working paper "Models for Operations."

These models are used to develop properties, skills, and applications of algebraic concepts, as desired in goal (3).

Goals (2), (4), and (5) require no elaboration.

From the experience of the first pilot year 1974-75, it was felt that all of the goals were met. But goal (2) was not met to a high enough degree. For this reason, the creation of supplementary mastery learning materials is being undertaken in 1975-76. These materials are found in a workbook which supplements the course.

Perusal of this workbook will show that a variety of presentations have been tried and tested. Programmed practice seems to work best, and we now include both pre- and post-tests for mastery in the workbook. (Originally pre-tests were provided in the teacher's edition.) For students who quickly master the materials, supplementary readings or recreations are provided.

Question 4: Is the content of these instructional materials scientifically correct?

To insure content correctness, full copies of the materials have been sent to and commented upon by the following people:

In mathematics departments: Izaak Wirszup, University of Chicago
James Schultz, Ohio State University

In statistics departments: William Kruskal, University of Chicago
Paul Meier, University of Chicago

In math. ed. departments: Lauren Woodby, Michigan State University
Max Bell, University of Chicago

The materials utilize both English and metric units of measure. Metric units are preferred and found in more problems than English units. However, English units are occasionally used when a "feel" for a given application is desired (e.g., mph over km/hr at times) or when there is no alternative given the application (as in football yardage). It is felt that this is a realistic split which will conform with guidelines and regulations regarding any metric switchover while at the same time taking advantage of intuitions gained from experience with the English system.

As much as possible, terminology and symbolism from contemporary algebra courses have been kept in this course. (The author cannot think of any change of this type.) As the notion of using models is first found in these materials, language needed to be developed there, but even that language is designed to conform with contemporary mathematical usage.

A great amount of data is found in the materials. Sources of the data include governmental reports, reputable almanacs, dictionaries, and other reference books. Questionable data is often the source of problems found in the materials. For example, the relative frequency of twins is given by various sources as 1 in 86 births or 1 in 88 births or 1 in 89 births. This "conflict" in data is interesting in itself.

Question 5: Is the content of these instructional materials educationally sound?

The entire purpose of the pilot teaching of these materials is designed to insure not only educational soundness but also to make it as easy as possible for students to learn the ideas found in them.

Schools and teachers have been selected on the basis of their representativeness of schools which may be found nationwide. Only typical algebra classes with unselected students have been used. The author has taught a class each day of the two years of pilot testing.

The approach taken in this course, in which real applications are used to develop the mathematics, is more in line with current psychological theory (e.g., that of Piaget) than contemporary approaches to algebra in which postulates are laid down and properties logically developed from them.

But it is felt that current psychological theory does not give surefire indications about the viability of materials and that classroom trials provide the best indications of such viability. Past experience of the author indicates that he himself must teach the materials.

Large-scale field testing of a revised version of the materials is planned for the 1976-77 school year.

The author is cognizant of the range of values found in the United States, and does not expect any controversy to be generated by the situations which have been selected for study.

A teacher who is accustomed to spending one-quarter of the course on factoring and fractional expressions will find these materials to be quite different. The "What about the SAT's?" question, used by teachers against any new program, is expected to be raised. It is hoped that the skill work in this course will muffle such objections.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

It is hoped that the following would be outcomes of having studied these materials:

A. A student would see mathematics as naturally tied to applications and thus not be surprised to learn that mathematics is required in a great number of fields.

B. A student would want to take more mathematics.

C. A student would learn about his or her world and the ways in which mathematicians try to study this world.

D. A student would learn the skills associated with first-year algebra and some fundamental skills associated with probability and statistics.

E. Arithmetic insights would be sharpened.

The author feels that these are desirable goals.

The materials have been written to be free from sex, racial, ethnic, or religious bias or stereotyping.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

The materials have been designed to be as easily implementable as possible. They provide an alternative to an existing course.

If all planned aids to the course were used by a school, there would be a workbook for each student. This would be the only cost not normally found in an algebra class.

Special training of teachers to teach the course seems unnecessary. For maximal usage, some reorientation of teachers with respect to the goals of algebra will be needed. Specifically, the problem will be to get teachers willing to teach the course. Once this willingness is there, no special training seems to be needed unless the teacher expects to be teaching exactly what he or she has been teaching in the past.

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

The proposal projects a total cost for the testing year 1976-77 of $55,000 and for the analysis of testing and other pre-publication work in 1977-78 of $35,000. These costs are based upon two assumptions:

first, that schools pay for the materials they use; second, that a publisher is working with the project beginning in early 1976 and assuming some of the development costs.

As stated earlier, one of the goals of the project is to come up with materials which are easily implementable. It is projected that training sessions may be used with some of the classes involved in the 1976-77 study. This would be necessary if one wished to test the benefits of special help. However, there are no plans in this project to undertake a major implementation effort. (This does not preclude the possibility that others might want to ask for implementation funding, but this director has no such designs and would be bothered if special workshops or in-service were considered necessary for the implementation of this program.)

If a school district would buy the entire "package" (i.e., the text and the workbook), then the workbook becomes a "refill" need. Policies differ among states and among school districts; for some schools students could pay for this refill, in other schools the district or state must pay. One assumes that such a paperback workbook would cost about $2/student-year.

Since many schools buy ditto-masters and other aids for similar classes, these costs do not seem to be significantly greater than comparable costs in standard programs.

No psychological or social "costs" seem to be involved here, in the director's opinion.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

At this time, the materials are purposely being produced in quantities which do not allow for wide distribution. That is, the pilot versions have been dittoed. For the first pilot version - a very rough edition of the materials - 125 copies were duplicated. This enabled copies to be sent to NSF as needed or required and there were copies for each of those commenting on the materials (see Question 4) as well as for the school districts in which the materials were being used.

We are presently duplicating 220 copies of the materials. Of these, 170 go to the 5 classes using the materials. We are keeping the other copies for use by commentors, NSF, and publishers (as a call is presently being planned).

For those who desire information about the project, a summary information sheet (June, 1975) has been prepared. A four-page paper entitled "Models for Operations," describing one of the ideas used in the materials, is sent to almost everyone who requests information. The

director has given talks to two local groups, one state group (in Michigan), and one NCTM regional meeting specifically about these materials; many of his other talks utilize ideas from the materials. A session is planned at the NCTM annual meeting in Atlanta in April, 1976, specifically devoted to this project.

Periodic internal memoranda have been written and provided to those who wish more detailed information about the project.

Any individual may visit any of the project classes at any time, though visiting on testing days is discouraged (for obvious reasons - one will not be able to see as much student behavior).

The director maintains contact with each of the teachers in the project at least twice a week. He visits each school at least once a week.

In the testing year 1976-77, it is planned to produce the materials in quantity. Any school district wishing to use the materials will be able to do so. Any person wishing to buy the materials may do so.

At times the director would have liked to have more administrative help - last year there was none save a 1/4-time secretary, this year there is a half-time assistant and a 1/3-time secretary. At times it would be nice to have more copies of the materials. But both these niceties are impossible under the level of funding which has been requested, a level of funding which in both funding years was at the limits of what was considered feasible by those at NSF.

On the other hand, given a choice, the director is happy with the policy of not presently producing large numbers of copies of the materials. In his experience, there is a great tendency for people to evaluate a project by the first materials they see. With his past curriculum efforts, he has found that wide distribution of the testing version serves to heighten usage, interest, and implementation. Preliminary versions serve very limited purposes.

The director has directed evaluations of two other innovative texts, and in one of these evaluations he did the analysis of data himself. Others have judged these analyses to be eminently fair - indeed in his analysis of Geometry - A Transformation Approach's testing version, many have said that he was too hard on his own materials. With respect to the present work, the director hopes to take only an advisory role in the evaluation, leaving the actual data collection and analysis to others who have not been involved in the writing and pilot editions.

Question 10: What are your general impressions of the curriculum?

The standard first-year algebra course is a disaster area. It turns off more students than it turns on. It gives a view of mathematics as a mechanical process devoted to the solution of equations,

simplification of expressions, and recitation of rules with very little framework for these processes other than an axiom system which is itself mysterious to most students. The hardest parts of the course are devoted to the least important ideas - word problems and rather complicated fractional expressions. At a time when mathematics is being used in more and more fields, this course is often being taught with fewer applications than it had, let us say, in 1925. (Evidence for this is found in a study by Bell.)

It is the hope of this project to create a feasible alternative to existing materials. Within the framework of the goals mentioned earlier, it is the hope that these materials will dispel the notion that "all algebra books are the same." On the other hand, it is hoped that the differences are not so great that they will discourage use of the materials.

The director's geometry materials have had an influence far wider than their actual use. He feels that these materials may be just as influential. In particular, they may lead to university courses in applications of mathematics for teachers, they may dispel the notion that mathematics must be advanced in order to have applications, and they may enable more students to get a feel for the importance of mathematics. He would not be surprised if these materials ultimately gain wide usage, but realizes that such usage depends as much upon the publisher selected and the tenor of the times as upon the quality of the material.

D. 10. c: FYA (Panel 2): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The assessment by the project director of the needs is a sound one based on both a consideration of opinions of well known mathematicians and mathematics educators, and a knowledge of what goes on in the classroom. His arguments support the need for the liberal use of applications in teaching Algebra. There are no satisfactory alternative instructional materials that start exclusively from a foundation of applications as these do.

The potential for the market is greatly enhanced by the name of the author. If teachers accept this work as they have the author's other works, it will reach many students. Teachers, administrators, parents and the industrial and business community are looking for more relevant materials based on applications. Their interest in this particular project has been reported by the author. This is a bold new venture in providing for the need for a complete course based on applications.

Question 2: Is there a market for these instructional materials?

There are first-year algebra courses that claim to focus on applications but they utilize the classic structure of content for their foundation. This project, however, is predicated upon applications--an approach used consistently throughout the materials from introduction to mastery of each particular topic.

Since no course in the high school mathematics sequence is more universal nor more accepted than first-year algebra, clearly there is a pre-existing slot for this material. Furthermore these curricular materials do not seem to require any extensive or external preparation of the teacher.

Although no plan for dissemination and/or publication has been identified, the reputation, publication record and acceptance of the project director by the mathematics education community insures ease of publication and wide adoption.

Question 3: Do these instructional materials possess a clear purpose and rationale?

A. What are the stated assumptions, values, and goals behind these instructional materials?

(1) Offer students a picture of wide range of applications.

(2) Develop symbolism from natural needs.

(3) Cover standard first year Algebra skills except for contrived verbal problems and complicated fractional expressions and factoring.

(4) Most teachers will accept these goals, but would not be able to "predict how the materials try to achieve them."

(5) It is supposed to be a natural psychological development.

B. What assumptions, values, and goals may be inferred directly from the instructional materials themselves?

Materials assume broad interest of students in applications. However, it should be noted that this text will be no more demanding than existing algebra texts.

C. Is it reasonable to expect that instructional materials based on these assumptions, values, and goals will fill the need documented in question 1? Are there alternative assumptions, values, and goals that could generate materials to meet that need?

Yes it is reasonable to anticipate these materials will fill the need documented in question 1. Students' actual daily experiences could be a source of information to be used in generating problem materials, i.e., parties, school activities, etc.

D. Are the instructional materials themselves clear and understandable? Do they form a cohesive package? Is the sequence of presentation clear?

These materials clearly constitute a clean cohesive sequenced content which will be understood by algebra students.

E. What is the rationale for the selection of individual curriculum modules (if there are such)? Is it plausible?

Results from pre- and post-tests will be utilized. Accordinglv, supplementary materials will be assigned to the student.

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>

A. To what degree are the instructional materials scientificall accurate?

The instructional materials are most accurate.

B. To what degree are the instructional materials scientifically current?

These materials are not only current in terms of appropriate number accuracy (i.e., gasoline prices, etc.) but in terms of the timeliness of the problems in general.

C. Is the content of these instructional materials aimed towards training future scientists or aimed toward a scientifically literate population?

The materials are aimed at developing scientifically literate citizens.

D. What portion of the discipline, and approach to the discipline, is represented by these instructional materials?

The text covers most of the topics in a beginning algebra course and in addition provides an introduction to probability and statistics. For the intended audience, many of whom will not study further mathematics, this addition is very worthwhile.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

A. Do you anticipate any adverse reactions to these instructional materials from teachers, staff, parents, or pupils? Are there any especially favorable reactions which may also be anticipated?

Teachers, staff, and students will react favorably because the program moves from application to properties. It is in itself reality oriented. Parents will react favorably because they will recognize the traditional algebra material and appreciate the application aspects of the materials.

B. Does the content/approach present any special cognitive, affective, or psycho-motor difficulties for the students at the age and development level targeted? Does the content/approach demonstrate ingenuity or possess special promise in its tailoring to learning styles and types?

Ninth grade students may not know or care about some of these applications.

C. Are there any students for whom this content/approach should not be used? Any for whom it would be particularly effective?

It would seem that this content/approach would be suitable for most students, but particularly suitable for career minded students.

D. What are the instructional materials' strategies for dealing with value-laden areas? Are they adequate? Are they particularly impressive or ingenious?

There is no evidence of biased material.

E. Please note additional questions and/or evidence you think important in answering this question.

If students are motivated by real life situations, then these materials will prove effective. Also, these materials are at least no less effective than traditional ones.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

A. What are the anticipated impacts of these instructional materials on <u>all</u> consumers: students, teachers, school districts, etc.?

The algebra course being developed under this program is intended to emphasize the application of mathematics in daily life. The course material developed shows a degree of imagination, cleverness and awareness that makes it seem very likely to achieve many of the intended results. An additional advantage of this treatment is that the carefully chosen examples convey useful quantitative information on a variety of topics related to everyday living.

B. Which of the intended effects would you expect to be realized as a result of using these materials?

As stated in A above, there is a good likelihood of achieving the major intended effects.

C. What unintended effects might you anticipate as a result of using these materials?

There are no particular items noted.

D. Is the content and approach of these materials fair; are they free of sex, racial, ethnic, and religious bias or stereotyping?

The material is unobjectionable with respect to these biases.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

A. Is special training needed by teachers to use these instructional materials effectively? What type of training?

No. Teachers who acquaint themselves with these materials and their purposes will be able to teach this course.

B. Do these materials pose any special problems for existing organizational structure with the schools?

No. The materials fit nicely into the existing algebra, geometry, advanced algebra sequence. The second year algebra teacher will need to be aware that pupils from this program will have limited skills in factoring.

C. Are the costs of these new instructional materials realistic?

Yes. The materials will be published and the cost will be similar to traditional texts. A workbook is also required. However, its cost will probably not exceed the duplication cost of material it would replace.

D. Do the new instructional materials require any special learning resources?

No.

E. Will the new instructional materials require school districts to establish optional classes for those who do not wish to use the new materials; e.g., are the materials value-laden, designed for bright students, etc.?

No.

F. What are the important process features (i.e., outcomes not derived from the content of the instructional materials but from other features such as method of instruction) of these instructional materials?

There are no particular items noted.

G. Please note additional questions and/or evidence you think important in answering this question.

There is some question of the effectiveness of the mastery method at this grade level. This is not a necessary part of the content but its use may make the material less effective.

Is the reading level of the materials appropriate for the average algebra pupil?

Are pupils who study this course as well prepared for advanced courses and for life situations as pupils from traditional courses?

Our overall impression is that teachers of mathematics as they are now trained would not have undue difficulty teaching this material to the typical algebra pupil in today's classes. Pupils will be able to master the concepts, the techniques, and will develop most of the skills that pupils in traditional classes possess at the end of the course. Pupils finishing this program should have a greater understanding of how mathematics is used in the world.

Question 8: Are the costs for implementing these instructional materials reasonable?

A. What are the expected total dollar costs for implementing these instructional materials (e.g., materials for learners, teachers, staff, training personnel, installation, etc.)?

The cost will be the cost of a standard textbook and consumable workbook. No special training, materials, or equipment will be necessary.

B. What are the costs of continuing use of the instructional materials; are there "refill" needs, support service costs?

Annual purchase of a workbook.

C. What other ways might the school district spend money to meet the same need?

School districts could use traditional materials and purchase supplementary materials and hire consultants to help in the classroom. This would be extremely difficult and the price prohibitive.

D. What are the expected costs of comparable instructional materials?

Comparable materials do not exist. Also, it would cost no more than its traditional counterpart.

E. What non-fiscal costs might be involved, e.g., psychological/social?

None.

F. Please note additional questions and/or evidence you think important in answering this question.

There are no additional questions relative to cost.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, TO WHAT DEGREE ARE THE COSTS OF IMPLEMENTING THESE MATERIALS REASONABLE? Please refer to the above questions in developing your answer.

The costs of implementing the materials in the classroom are reasonable.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

A. Has there been adequate opportunity for all interested parties (scientists, educators, lay people) to provide input into development of these materials?

While there was no formal solicitation of input, the project director's experience, his direct involvement in the classroom and with classroom teachers, his presentations to professional meetings, and his use of a competent advisory committee provide adequate input from interested parties. The materials developed so far support this view.

B. Are there adequate internal monitoring procedures for the project?

Adequate internal monitoring is provided by the project director's direct control over writing and classroom trials. This is a relatively small project both in budget and manpower.

C. Are there adequate external (independent) evaluation procedures for the project?

Feedback is being obtained from teachers and students in the classroom. The advisory committee reacts to all written materials. Early contact with publishers can be expected to yield some critical discussion about the articulation of project materials with existing pre- and post-first year algebra textbooks. And NSF maintains adequate contact with the project. We believe this to be adequate external monitoring.

D. Does the project seem to be top heavy administratively? Does the project seem to be too thinly administered?

The project is essentially a one-man operation; consequently administration is not a crucial concern.

E. Is the project staff providing adequate information to NSF and other interested parties?

This project is providing adequate information to NSF. Indeed, the informal "progress memos" are commendable and might well be adopted by other projects funded by NSF.

D. 10. d: FYA (Panel 2): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

NSF Staff Note: Panel 2 chose not to submit individual comments on each project, but rather submitted a response of the whole panel to the 10th question. In addition, one panelist submitted general comments which apply equally to all five curricula reviewed by Panel 2, and which have been agreed to by all other members of the panel.

Panel 2's common response:

The First-Year Algebra Through Applications Development Project is the first such curriculum which is selectively formulated from the everyday life experiences of students in an effort to permit and encourage students to solve real life mathematical problems. These applications are mathematically sound and probably more motivating than their classical counterparts. By virtue of the documented and professionally felt need for such materials coupled with the well known and respected name of the author, it is anticipated that the finished product will become a "Best Seller."

Although these materials appear to have the potential of making a valuable contribution to the teaching of algebra, the following recommendations are provided as a means of strengthening them.

a) The reading level of the materials must be carefully established and modifications made to assure that it is appropriate for the target population at which the project is directed.

b) Appropriate evaluation techniques ought to be employed to determine if students taught from these materials are adequately prepared for advanced courses in high school mathematics and life situations as compared with pupils from traditional programs.

c) The mastery learning aspect of the project should be evaluated.

d) The degree to which students participating in the project satisfy project objectives should be determined.

e) An evaluation team independent of the project should be be engaged to provide the evaluations recommended in a, b, c, and d above.

General comments prepared by Professor John Allen Easley, Jr., and agreed to by all other members of the panel.

At this point, it is clear that many of the innovative curricula introduced during the 1960's - in particular, many of the "new math" programs - fell far short of the anticipated effectiveness. To insure greater effectiveness in future curricula, each and every new project must be required to look carefully at the shortcomings of the corresponding programs of the 1960's.

There is little evidence that this has been done in the five mathematics projects under review by Panel Number 2 (nor is it being done in most other projects in math and science known to the panel). Instead each project makes its own new guess as to what needs to be done to improve the present situation.

If it is reasonably easy to test such a guess, there is certainly no harm in it. In fact, some of the least expensive projects we reviewed are the most promising. But if the cost of implementing an innovative idea is very large, then we must put forth the strong suggestion that one inquire whether the particular project is worth the cost of implementation. The great difficulty in implementing this suggestion is that the people who are experienced and talented in creating curriculum materials are rarely trained or competent in carrying out such evaluative checks; nor are they, as a rule, sufficiently detached. What is sorely needed in such evaluations is for those who are inventive in creating new curricula (Usiskin, Pollak, etc.) to be teamed with those who are trained in inquiring into educational programs and institutions.

There are two groups of professional investigators who can help:

1) Responsive evaluators.

2) Cognitive analysts.

At present, the NSF is not supporting this kind of study. As a result, we are facing the danger of a substantial breakdown of communication between the scientific community and the schools. This is reflected in Congress as well as in the lack of enthusiastic reception of many NSF sponsored curriculum projects in schools. To correct this trend, we need not only new surveys of needs but a greater interest of NSF in gaining knowledge about what works and what doesn't work in the introduction of new materials and practices--and why. As we see the projects reviewed by Panel Number 2, a more careful review and evaluation is needed before very large amounts of money are committed to the production of materials. Not only is input needed from a broader range of persons--even the most talented curriculum innovators often overlook certain points of view which are important--but experimental and pilot studies of the innovative ideas should be carefully tested before large sums of money have been committed to materials development.

Experimental trials of carefully revised materials, selected to test the key ideas of the project (perhaps taking only a month or two of school time) to learn teachers' and pupils' perceptions is a kind of research that is much needed. The teaching in these trials must be carefully described and not just results on pupil tests. In addition, both formative and summative kinds of evaluation are needed for curriculum projects. Testing ideas as they come up on a day-to-day, rough draft basis is something that goes on in most projects, but it often needs to be more detached or even more critical than it is. Summative evaluation is needed not only to test whether the intended ideas are learned, but what else was learned that might enhance or detract from what has been taught.

Additional comment by Mr. Daniel J. Hogan:
"I don't agree completely with this statement for the following reason. Although the type of evaluation suggested by Dr. Easley is commendable and should be done, I do not believe that the bureaucracy can stand another outside group. I believe the addition of this kind of expert to the NSF staff would better serve the organization."

D. 11. a: OBIS: NSF Descriptive Information

PROJECT TITLE: Outdoor Biology Instructional Strategies (OBIS)

PROGRAM: Science Curriculum Development

PROJECT DIRECTORS: Dr. Watson M. Laetsch and Dr. Herbert D. Thier

INSTITUTION: University of California, Berkeley

DEPARTMENT: Lawrence Hall of Science

BUDGET: Total Granted: $919,400

Dates: 4/15/72 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Outdoor Biology Instructional Strategies (OBIS) has its major goal the design of instructional strategies for outdoor learning activities in biology that can be applied in diverse environments. Activities of both independent and sequential design are used to promote an understanding of ecological relationships by youngsters from age 10 to 15. It is anticipated that approximately 200 activity folios will be produced so that community and school groups will have a wide choice of materials to use.

PROJECT SUMMARY

OBJECTIVES:

Outdoor Biology Instructional Strategies (OBIS) has its major goal the design of instructional strategies for outdoor learning activities in biology that can be applied in diverse environments. Activities of both independent and sequential design are used to promote an understanding of ecological relationships by youngsters from age 10 to 15. It is anticipated that approximately 200 activity folios will be produced so that community and school groups will have a wide choice of materials to use.

ACTIVITY PLAN:

Each OBIS activity will undergo an exploratory phase, a local trial, and a field-test phase during its development. The following idealized description of the three phases describes the operational approach to development of the project.

Exploratory phase. Using the OBIS Ecological Mosaic, a concept, technique and/or environment is identified as necessary for accomplishing the overall project objectives. Project staff members, using groups of learners available at the Lawrence Hall of Science, the University Botanical Gardens, and other local agencies, try out and evaluate promising ideas. Based on these explorations and related library and laboratory research, early written versions of applicable activities are produced. Further use with learners leads to complete versions of the printed materials and related equipment. This is the output of the exploratory phase and includes tentative folios and necessary specialized equipment and materials so that a small number of nonproject staff leaders can test the materials in the San Francisco Bay Area. The exploratory phase for a given problem or environment will take from a few weeks to as long as six months.

Local trial phase. Exploratory folios selected for further development will be tried in the San Francisco Bay Area by three to five instructional leaders who are not a part of the project team. Drawn primarily from community groups, these individuals will give the project staff its first feedback on what happens when an "outsider" uses the materials. During local trials significant modifications in scope, sequencing, and required equipment and materials may be necessary. Project staff will carefully monitor these local trials using techniques similar to those described for the trial of the lawn and pond unit. As a result of the feedback collected during the local trial, the project team will rework the activities to produce the trial versions of the folios and related equipment and materials. These trial versions of the folios will be used for field testing and be made available to the interested public.

Field-test phase. The trial versions of all OBIS folios will be field-tested in ten to twelve centers. These field tests will have four main purposes.

1. Trial and evaluation of the overall instructional and operational strategy of the project away from project headquarters.

2. Use of the activities in a geographically different area, where it is necessary to make the local adaptations discussed earlier. (The field test of each OBIS folio is essentially the laboratory for that set of activities, in which we determine the feasibility and ease of adapting the activities to various local conditions.)

3. Trial of certain evaluation approaches which seem applicable for OBIS. (This trial of evaluation approaches will provide feedback on what is being learned from different folios. It will also provide information on attitudinal changes brought about by the use of OBIS materials. This feedback on early folios will be most helpful during the design of subsequent folios and also during the necessary revision of the tested folios.)

4. Trial and evaluation of the various suggested sequences for using the OBIS folios included in the field test.

Each project supported field test of OBIS materials will include 20 to 24 related folios so that field test leaders can explore and try out a number of different approaches to the sequencing of these folios. For this reason, initial field tests of new OBIS materials will take place once a year. It is expected that community and school groups associated with field test centers will, however, use OBIS materials during much of the year.

The field-test leader will interpret the concepts and approaches of the project to the individuals who will work with groups of learners in that area. Implementing the necessary local adaptations, and suggesting sequencing of activities, is also a function of the field-test leader. Five-day leadership training experiences were to be held for the selected field-test leaders at the Lawrence Hall of Science during spring and summer 1974. It is expected that, in addition to an honorarium (where necessary), travel and per diem for the time spent in Berkeley, each field-test leader will be compensated by the project for each dissemination, training and feedback session held during the time field tests are taking place in his or her area.

First field tests of the revised OBIS materials will take place during summer and fall 1974. Choices were made to provide for a wide variety of environmental conditions. Individual leaders and/or host institutions were chosen because of their leadership capabilities and interests in materials like OBIS.

This first field test of OBIS folios (summer and fall 1974) will be completed during this proposal period, and it is planned to begin the monitored field test of the second set of OBIS folios in spring or early summer of 1975.

Based on information obtained from the field-test leaders, and by project staff visits, necessary revisions of each folio will be completed. Some folios will probably need little or no change from the trial version while others will require extensive revision. These tested and, if necessary, revised folios will become the final products of the project. They will be generally made available to the interested public in a variety of ways currently under study.

ORGANIZATION AND MANAGEMENT PLAN:

Project Leadership:	Responsible for the overall design, development and carrying out of the project's objective and operations.
Development Teams:	Responsible for the design, trial and production of the various OBIS folios.

Implementation Teams: Maintains working relationship with the field test centers and designs and carry out other implementation activities of the project.

Evaluation Team: Design, carry out and analyze evaluation techniques to meet the needs of the development staff and the user groups of OBIS.

Support Staff: Necessary to accomplish the production objectives of OBIS.

PERSONNEL:

Project Director: Watson M. Laetsch

He is Professor of Botany, University of California, Berkeley, and Director of the Lawrence Hall of Science. He received his B.A. from Wabash College, Crawfordsville, Indiana in 1955 and his PhD. in biology from Stanford University in 1961. He was a Fulbright Fellow at the University of Delhi, India in 1956-57 and an NSF Senior Post-Doctoral Fellow at at University College, London in 1968-69. He is a member of the American Society for Developmental Biology, and was elected a Fellow of the California Academy of Sciences in 1968. Dr. Laetsch was a teacher in the public schools of Indianapolis, Indiana in 1957-58. He directed NSF In-Service Institutes for High School Biology Teachers for three years and directed the biology portion of NSF Summer Institutes for High School Science Supervisors and Department Heads for two years. He is currently director of an NSF Cooperative College-School Science Program for junior high school teachers.

D. 11. b: OBIS (Panels 5 and 6); Project Director's Response to 10 Review Questions

Introduction

The purpose of this paper is to present information about Outdoor Biology Instructional Strategies (OBIS) useful to the review panels and the National Science Foundation in regard to their review of active pre-college curriculum projects in science. This information is related to the major questions raised in the copy of the memo to panel members sent to the OBIS project on November 11, 1975.

The OBIS Project

Outdoor Biology Instructional Strategies is developing both independent and sequential activities to promote the understanding of ecological relationships by youngsters from ten to fifteen years of age. The major goal of OBIS is to design instructional strategies for youngsters in outdoor biology that can be applied in diverse environments. Particular emphasis is on the man-managed environment.

OBIS activities are primarily oriented toward community-sponsored youth organizations such as Scouts, 4-H clubs, Camp Fire Girls, recreation camps, summer camps, after-school clubs, and nature center groups. The activities introduce basic concepts of ecology in ways that are palatable and exciting for youngsters. Programs such as OBIS are necessary to develop the public understanding required to support appropriate management of man's environment.

OBIS takes place in the "freedom of choice for the learner" atmosphere characterized by informal education for at least two reasons. First, a great deal of learning by children and adults takes place in informal situations. Second, informal learning is usually enmeshed in a social context. It involves groups such as playmates, scouts, or family members and the group interaction plays a critical role in the learning. Therefore, it seems plausible to assume that skills, understanding, and points of view acquired in such a free choice informal atmosphere will be more related to the actual life of the learner and will have a greater possibility of affecting the day to day and long-term behavior of the learner.

OBIS and the Community

The project's overall intent and the desired interaction between OBIS and the community groups it tries to serve are characterized by the following quote from an article by Eleanor Thomas, Program Director, San Francisco Bay Girl Scout Council:

> "The advent of OBIS in the San Francisco Bay Girl Scout Council marked the introduction of a new dimension to the Girl Scout program that has been accompanied by a new wave of enthusiasm for taking groups into the out-of-doors. For leaders, camp counselors, and trainers, OBIS

has become the magic word that spells simple, enjoyable, easy-to-handle learning experiences for our girls in an outdoor setting.

"It all began with an invitation to participate in a Community Group Leader's Workshop conducted by Outdoor Biology Instructional Strategies (OBIS) at the Lawrence Hall of Science over a year ago. The statement in the invitation that created immediate interest was: 'If people are to make intelligent decisions about the environment, a basic understanding of ecological relationships is essential. OBIS... is concerned with promoting this understanding.' This statement had great appeal to a youth organization whose basic aim is to develop responsible citizens who are equipped to help make intelligent decisions, and one that has been committed to the out-of-doors as its most effective "open classroom" since Scouting began.

"Participation in the Workshop served to reinforce all the initial impressions that OBIS and the Girl Scouts had much in common:

- Concern for the future of the environment.
- Discovery approach to learning for youngsters.
- Instant creative program materials for busy volunteer leaders who need not be biologists or scientists to 'teach' biological relationships.
- A mutual commitment to the outdoors as the laboratory and the classroom.
- A conviction that community organizations and the academic community have much to gain from collaboration."

It is this kind of relationship that OBIS is fostering between the project and a diversity of community groups and their members on a nationwide basis.

Question 1: Is there a genuine need for these instructional materials?

Approach to determining needs. Since 1973 OBIS has made a systematic effort to survey and interact with the variety of community groups on the local, regional and national level.

The reasons for this were three-fold. First, to find out the extent of community interest in a program like OBIS. Second, to get to know and understand the nature of community groups so that the OBIS materials could be designed more effectively. Third, to try out and obtain feedback by means of conferences, leadership workshops, and training sessions on the content and design of OBIS materials.

This interaction began with a survey and Community Group Conference on the local level (Report included in the reviewer's Packet) and is continuing on the local, regional, and national level. During 1975 OBIS has carried out a workshop or other information and training program for leadership staff of the following groups: Boy Scouts of America, National; Girl Scouts of the U.S.A., National, Regional, and Local; State and Local Park and Recreation Districts; YMCA; University Environmental Centers and Departments; School Enviornmental Centers; National Jewish Welfare Board; American

Camping Association; Camp Fire Girls; Salvation Army; National Park Service; 4-H, National, State, and Local; Junior League of Oakland.

Information Obtained. The contracts with these groups have provided extensive information regarding the level of competency and interest of leaders to use activities of varying complexity and sophistication. Each of these groups has expressed continuing interest in the OBIS project and is using OBIS materials at the present time. This usage ranges all the way from early trial and testing by some groups, to massive implementation and training programs by groups as diverse as the American Camping Association, California State 4-H, and local and regional councils of the Girl and Boy Scouts. Groups currently using OBIS represent a potential user population in the neighborhood of ten to fifteen million young people.

Community groups want and need a diversity of instructional materials. They need these materials for both one-time experiences for visiting groups and intensive programs for studying particular aspects of the environment over a longer period of time.

Most groups consider leadership training to be essential if they are to successfully adapt and use the instructional materials developed by OBIS or anyone else. Since these groups generally use a large number of volunteer leaders whose time, commitment, and length of service are limited, it is important to design ways of multiplying the long-term effects of the training provided.

It is significant that although programs exist which share the stated aims of OBIS, they are not fulfilling the community group desire for stimulating programs in outdoor biology. The best evidence of this is the great interest shown by these groups in OBIS. Even groups such as the American Camping Association and the Boy and Girl Scouts, which have developed their own ecology programs, see OBIS as a most enriching experience for use in their organizations.

Curriculum development projects must take cognizance of the fact that children can obtain a great deal of their education outside the formal classroom. Since appropriate curricular materials have not yet been developed for environmentally oriented life science education activities in the outdoors, community groups are unable to cope with the increasing societal desire for significant programs in outdoor biology. OBIS sees its role as contributing to meeting this need.

Question 2: Is there a market for these instructional materials?

The OBIS market. The primary market for OBIS materials is community groups and certain aspects of the school program such as school camps, after school clubs, and summer school programs. During the past few years a large number of "environmental education" materials have become available. Many of the groups working closely with, and already extensively using OBIS, have produced materials of their own but have found them lacking for one or more reasons.

The format, approach, and content of OBIS materials make them highly marketable to community groups because they include the following important characteristics:

1. A basic concern with promoting an understanding of ecological relationships in the man-managed or disturbed environment.

2. A community group orientation which places OBIS in the realm of free-choice recreation activities.

3. Motivating entrance activities which are both fun and challenging to youngsters and leaders.

4. A discovery method approach to learning using hands-on, open-ended investigations.

5. Inexpensive materials are provided for use in investigating the outdoor environment in a format that does not threaten the untrained leader.

6. Materials can be used in diverse environments throughout the nation and can be integrated into already existing programs.

7. The materials are highly flexible and therefore can be fitted into existing programs or form the base of a new program.

8. The materials are non-threatening to leaders who have little or no background in science or education. Thus they feel they also can handle the program.

9. The materials are attractive and well organized, and therefore appeal to the user groups.

Other programs currently available in environmental education do not meet some or all of these criteria. Therefore interest in and utilization of OBIS materials are high and are growing.

OBIS Dissemination Plans. The groups for whom OBIS is intended are highly individualistic, and although national in organization, depend on local and regional associations and boards for their actual support and operations. Budgets are limited and prior exposure to dissemination of materials has been through announcements in organization newsletters or "new requirements" for participants. Neither of these approaches leads to a long-term intellectual or operational commitment to a program as evidenced by the lack of growth of in-house environmental programs in many organizations now extensively implementing OBIS. The OBIS approach is to inform and convince national leadership of the value of OBIS and then to develop a plan for the trial, use, and internalization of the materials into the ongoing operations of the group. Depending on the organization and its nature, this can take a number of different approaches. For example, with the Girl Scouts it was deemed most advantageous to proceed on the local level with the San Francisco Bay Girl Scout Council (about 150,000 girls) as an exemplar to the national organization. Leadership training and feedback sessions have been held, use has been monitored, and, as concrete evidence of internalization, a special leader's patch signifying competence in OBIS has been designed and is currently available from the council. These

developments have been observed and discussed with the national organization and plans are currently underway for expanding the use of OBIS in Girl Scouts on a national level

With the American Camping Association (the professional National Association of Public and Private Camps) on the other hand, the emphasis has been on working with the national group and their affiliated regional ecological trainers. Supported cooperatively by an NSF implementation grant to ACA, OBIS has participated in the training of these leaders in the approaches of the project and they in turn have provided leadership training in OBIS to counselors and other camp staff as a regular part of their ongoing service to ACA. Interest in the materials and their use has been so successful that currently discussions are going on relative to designing and making available a special ACA version of the OBIS materials which would then become part of the organization's program recommendations to its members. As can be seen from even these two examples, dissemination of OBIS is a complex but rewarding task which will require some external support but can depend extensively on the ongoing operations and staff of the user groups. Essential to this effort, however, is the maintenance of a high degree of flexibility in the format and availability of OBIS materials.

Market Response to OBIS Trial Materials. It is important to note that OBIS is not only entering a market, but to some extent is creating one. That is, community groups and others involved in informal education are not used to having materials prepared for them by outside agencies (especially funded research and development groups) and, therefore, the marketing of OBIS materials is as innovative an approach as the development of the materials themselves. Previously, the typical marketer of educational materials has been the publisher and these individuals are not used to (nor should they be) calling on the local scout troop, recreation center, or summer camp.

A good indication of the market interest in OBIS materials is given by the history to date of the production and distribution of OBIS Trial Edition Set 1. The first production of these 24 folios was completed in June 1974. Two thousand sets of folios were produced and since these were considered trial versions, no effort to promote their sale was made beyond announcing them in the newsletter and making samples available to OBIS Field Centers and at workshops. It was estimated that this production run of 2,000 would meet public demand and project needs for 1-1/2 to 2 years. Six months later, in January, 1975, the supply of folios had been exhausted. Reprinting, with some revision based on feedback received, took place in February 1975.

It is interesting to note that in the distribution of the first 5,100 OBIS packets, about 4,750 were sold and 350 were distributed free for project purposes. About 30% were sent to individuals in schools or school systems while over 40% went to leaders of community groups. Another 20% were distributed to colleges and universities where one can assume they will be seen and used by both school and other community environmental education groups. This rough breakdown indicates that OBIS materials appeal to a wide variety of community and school groups.

There is significant interest in OBIS and a major market for the output of the project. Final distribution plans for the materials will have to envolve out of the current experience in marketing the trial versions.

Question 3: Do these instructional materials possess a clear purpose and rationale?

Assumptions and Goals of the OBIS Project. Man must learn to manage his environment in an intelligent fashion. It is imperative that basic ecological principles are understood at an early age. Such an understanding can best be acquired through experiences with real events in real settings, and this means the study of biology in the out-of-doors. Outdoor Biology Instructional Strategies is primarily developing models for teaching outdoor biology to students ten to fifteen years old, but experience with materials already developed indicates that they are also interesting and of value to learners both older and younger than this age level. Thus materials are being tried with students at various levels and with family groups in which there is a wide range in ages.

Sequencing the Learning. Rather than determing a single sequence of learning activities leading to specific concepts, the OBIS staff is identifying and testing a variety of alternative strategies and techniques for environmental study. The strategies under development are primarily directed towards use in man-managed environments which are often in the student's immediate neighborhood. The learning groups are such community organizations as Scouts, 4-H, science centers, and summer camps, in addition to informal and formal school groups.

Need for the Folio Approach. Information gained during the early stages of the project resulted in the realization that the school "unit" style organization of materials is not appropriate for community group programs. Feedback from users suggested the desirability of activities that can be used independently or in sequence with other activities. Thus OBIS materials are currently available as single folios containing an activity of high interest which can be used as a one-time outdoor experience. A number of folios can also be combined to provide an integrated study of a given habitat (lawn or pond), and in-depth study of a concept (adaptation) or an investigative technique (sampling). Specific suggestions for how to do this form an important part of OBIS training programs and are included in the Leader's Survival Kit folio which is included in the sample set of materials sent to each of the reviewers.

OBIS materials can be adapted to local conditions anywhere in the United States, and enable community group leaders to introduce ecological concepts in ways that are palatable and exciting for learners of various ages. Science can only be relevant to the students' out-of-school experience if it constitutes an interesting activity willingly participated in by students choosing how they spend their free time. Work on the development of other informal strategies for presenting materials such as individualized experiences is currently underway.

Question 4: Is the content of these instructional materials scientifically correct?

Scientific Accuracy. Responsibility for scientific accuracy of OBIS materials has been assumed primarily by the development staff. OBIS activities are concerned with illuminating very basic biological concepts, particularly those related to relationships between organisms and organisms and their environment. Our target population, including the youth group leaders who act as instructors, has little, if any, scientific training and a major challenge of the project is to translate these basic concepts into a form which will lead to understanding. Since we are not concerned with highly technical material, we are not dependent upon specialized subject matter experts.

The development staff has a strong scientific and teaching background and is well-versed in basic biology. Two members of the staff have Ph.D.'s in Biology and the staff as a whole have many years of experience teaching at various levels in areas of general biology. All materials are monitored by all members of the development staff so there is a strong system of internal checks. The University of California represents a rich source of specialized talent, and the development teams make regular use of this talent.

Other checks on scientific accuracy have been performed by participants in our leadership training programs, and by staffs of the trial centers. Both groups contain professional biologists, and they have reviewed our materials in great detail. Over two thousand community group leaders have been trained in the use of OBIS materials, and this population also contains many experienced biologists. The project has received extensive feedback from many sources across the nation, and to date scientific accuracy has not been questioned.

Interpreting Science to the Public. A major concern has been that scientific accuracy does not fall victim to oversimplification. This is a constant problem for OBIS because motivation plays a very large role in our program. We are aware of the difficulty in maintaining balance between clarity and over simplification and we will continue to devote considerable resources to insure that this balance is not lost.

The primary purpose of the project is to increase general scientific literacy, not to train professional scientists. We are providing both an awareness that science is an interesting and worthwhile activity, as well as providing tools which will permit people to do science in the same way that they engage in many other endeavors. One of our major problems is to overcome the fear of science which most adults have developed and to show kids that science is an interesting activity relevant to their daily concerns. If we are successful in these objectives, it follows that a larger segment of the general population will be willing to consider science as a career, or at least as an area worthy of continued formal and informal study.

Question 5: Is the content of these instructional materials educationally sound?

Learning Styles and OBIS. The OBIS materials are intended for use in the "freedom of choice by learner and leader" atmosphere of informal education. Therefore, the leader and the group can select activities and combinations of activities that are especially tailored to their interests, learning style, and maturity. For these reasons, the OBIS materials are currently being used with a wide variety of users ranging from Brownie Girl Scouts (7-9 years old) to senior citizens groups. The emphasis on real experience and high interest for the learner make it possible for individuals of widely different learning styles and capabilities to have highly successful experiences in OBIS. Some examples of how OBIS has already been adapted to highly diverse groups of learners are given in the article OBIS Can Adapt! in Newsletter 4, Fall 1975, which is included in the sample materials for reviewers that go along with this report.

Educational Approach of OBIS Materials. OBIS is developing approaches to learning experiences in outdoor biology that can be applied in diverse environments. Man-altered environments have been chosen as the study sites, rather than classic climax ecosystems, because so much of the world is now environmentally man-altered and so often actively man-managed. The need for such an approach is widely recognized. The California 4-H program, for example, is increasingly concerned with the needs of young people in urban environments. They see OBIS as a valuable resource in meeting this challenge.

Most OBIS activities are suitable for both large and small groups of young people, and many can be adapted for individualized use. Materials are being developed for leaders who may have little or no background in biology or training in childhood education. We are also experimenting with using OBIS as the basis of family-oriented outdoor activities.

OBIS activities introduce basic concepts of ecology in ways that are palatable and exciting for youngsters. Underlying all materials is the assumption that a basic understanding of ecosystems, communities, populations, food chains, and interactions of organisms with their environments is essential if people are to make intelligent management decisions about their environment. The decisions themselves, however, will be based on a combination of scientific and experiential evidence and other value laden judgments which the individual will make. OBIS provides the kind of experiences and information which will help the individual consider, understand, and give credibility to the evidence at hand. The individual should then be more capable to make an intelligent decision about the problem. In designing and carrying out its own activities, OBIS does everything possible to protect and improve the quality of the environment. Techniques useful for the study of man-managed ecosystems are universally applicable where there is life; they are not limited to any specific environment or local environmental problems.

Unique Educational Nature of the OBIS Approach. OBIS departs from the common curriculum-development procedure of determining a single sequence of learning activities leading to specific concepts. Instead, alternative strategies are identified and a variety of techniques for environmental study are encouraged. Assuming that no single learning pathway can be either interesting or applicable to all people in all locales, OBIS designs flexible ways of sequencing activities which allow choices in terms of getting started, selecting the emphasis, and deciding how far to pursue the topic. In addition to biology, the physical sciences, social sciences, literature, art, and psychology are being used as potential starting points that will lead toward understanding ecological problems and relationships.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

OBIS and the Schools. Direct contact between the OBIS staff and school personnel has been limited to a few workshops held at national conventions of the National Association of Biology Teachers and the National Science Teachers Association, yet the number of identifiable school personnel who have purchased packets of OBIS Set I materials is about 30% of the total number of orders received. The community group sector, is both the bulk purchaser and user group, and the primary source of information to the schools who learn about OBIS and then purchase materials.

Impact on Community Groups. From a qualitative standpoint the impact upon the community groups has been very substantial. Many groups have adopted OBIS as their ecology program and others are combining OBIS with the activities they used prior to learning of OBIS. Very few community groups have had any kind of prepared curriculum-type materials and OBIS has been "just what they are looking for" according to them.

From a quantitative viewpoint, we estimate that only 5% of the potential users in the United States have even heard of the OBIS Program. This is because of the limited exposure resulting from only one year of implementation and the lack of a "grapevine" among most community groups, many of whom compete for the same youngsters.

An increased knowledge and awareness of the interdependence among organisms, and between organisms and their abiotic environments is the prime OBIS goal. Unintended effects that can result from the implementation of OBIS materials range from over zealous lay leaders who may use OBIS as a springboard to preach conservation, to children who because of their OBIS experience will develop an interest in the biological sciences as a future professional field.

Biases in OBIS. Biases are present in all written materials and OBIS, probably contains some which have escaped our efforts to remove them. However, our emphasis on the man-managed environment including the city, all boys and girls in the out-of-doors, and as wide a range of general

biological principles as possible make for a culture, race, ethnic, and religion-free program. The youngsters do little reading and the activities are not academically difficult, thus removing potential proficiency biases. A distinct bias exists against leaders using the program indoors.

Process Features of the Program. Important process features of the program include such important items as: skills in observing, graphing, counting, reporting, analyzing, comparing, manipulating experimental variables, cooperation, use of reference guides, assembly of tools, innovative thinking and expression, and decision making. Also introduced in OBIS, synthesis or the combining of data in a new way to construct a solution to a problem, is an important process which when coupled with hypothesizing, becomes a powerful scientific skill applicable to many future experiences.

The outstanding feature of OBIS is not the program or the activities as such, rather it is the mix of children, leaders, biological acitivites and the outdoors environment which stimulate learning in the informal (and influential) learning situation. OBIS provides the leader with a vehicle and a mode of leadership with which to interest and involve the naturally curious youngsters in the world of biology found everywhere out-of-doors.

Desirability of Concrete Experience. The desirability of providing concrete experiences for children working with plants and animals in the environment in which both the organisms and the children live is clear. The mysterious and sophisticated world of nucleic acids, microscopes, and protein synthesis, is not for the 10-15 year old youngster who doesn't yet know frogs depend on plants for food, that crayfish circulate whatever they live in through their bodies, and that populations change as habitats and environments are altered.

OBIS and its Users. Through our continuing contact with community and school groups in conjunction with implementation and feedback conferences and our own development work with groups of children, we can say that proposed and anticipated outcomes are quite congruent. OBIS has continuing feedback systems which provide us with information on which to base changes, if necessary, in everything from our basic instructional plan to the art work illustrating the construction of a sweepnet. Many community groups of diverse natures utilize the OBIS materials in varied ways, each exercising their best judgment and following their own dictates. This is a procedure we admire and encourage (See OBIS Can Adapt! Newsletter 4, Fall 1975).

Question 7: Do these instructional materials present implementation problems for the schools?

Introduction. The OBIS materials are designed primarily for community groups and therefore this question and its parts will be considered first from the point of view of the community group. Since there is significant developing interest in OBIS on the part of the schools, the points presented will then be related to the school situation.

Leadership training necessary to use OBIS. The materials are specifically designed so that a leader untrained in biology or education can use them effectively. Evidence from field centers and other trials indicates that the folio format combined with the direct instructions to the leader on what to do, provide a program the community leader feels confident to use. Realizing, however, that when available, effective leadership training would benefit both the program and the leaders, the OBIS staff investigated approaches to leadership training in cooperation with the San Francisco Bay Girl Scout Council. Two one-day workshops were held in June and September 1974 to train about 90 senior trainers and camp program leaders. This led to extensive use of OBIS in camp that summer by the leaders the project trained, and, even more important, these leaders and the other trainers have now run numerous workshops and other training sessions for neighborhood coordinators and local troop leaders. This experience indicated that it was possible to provide leadership training in a one-day workshop which would give the participants confidence to introduce the OBIS approach to other leaders in their group. During the spring and summer of 1975 this approach has been tried out on a statewide basis with the California 4-H program and it has led to many second level workshops handled by individuals trained by OBIS, and even more important, wide use of OBIS materials as a part of the 4-H program in California. Experience so far indicates the following:

1. Individuals who receive training at a one-day workshop are capable of introducing OBIS both to children and other leaders in their group.

2. OBIS can be handled effectively by the usual community leader without any special training.

3. Training, however, is valuable and OBIS is producing a "Primer" on how to lead an OBIS workshop in order to encourage trained leaders to carry on training sessions for other leaders.

Cost of OBIS materials. The cost of using OBIS is extremely low for a number of reasons. First, with the wide variety of materials available at low cost ($7.75 and $9.50 for a set of 24 activities) the individual leader can select activities that fit into the environments and budgets available. Second, some activities require no materials at all, while others require available materials such as paints, nets, etc. Wherever possible, instructions are given for constructing materials and unusual or hard-to-get materials are made available at low cost through the Lawrence Hall of Science. Third, any necessary printed materials for users are presented on cards, and the leader is encouraged to reproduce them locally. The folders are durable and replacement costs are restricted to consumables. Many of these are household items individual participants can bring with them to the activity.

Required learning resources. OBIS materials are specifically designed to work in a wide variety of learning environments found where people are. The main equipment and materials needed to do OBIS are in the out-of-doors.

The wide variety of folios (48 at present) makes it possible to do OBIS in a wide variety of environments. Work is continuing on developing new activities for as widely diverse a group of environments as possible. The proposed OBIS trial centers will operate to adapt and modify folios so that they are particularly effective in environments in other parts of the country.

OBIS and the schools. Although OBIS is not primarily intended for the schools, significant school interest in OBIS materials has developed. Schools and school systems are using OBIS materials as part of their summer school programs, school camp programs and after-school clubs and activities. In addition, a growing number of schools are reporting the use of OBIS folios and modules as part of an outdoor experience built into a junior high school science experience. Since the schools make the decision to use the materials because of a need in their program, the implementation of OBIS is not a problem, organizationally. Furthermore, the low cost of OBIS materials makes them particularly interesting to the school extra-curricular and camping programs which are frequently short of funds. Our experience so far indicates that the use of OBIS in the schools is as a result of the desire of an individual to utilize the materials in his or her own program or in a program the individual directs. Therefore, the conditions necessary for utilizing the materials have already been considered. It is not something imposed on the teacher or others by the administration.

Question 8: Are the costs for implementing these instructional materials reasonable?

Costs for user groups. The cost for a user group to implement OBIS is minimal. OBIS worked directly with community groups from the outset of the project and it was clear that such groups worked with very low budgets. Thus costs have been kept as low as possible.

Two examples, one for the scout troop leader with 12 youngsters over an eight-month period, and one for a camp with 60 different youngsters each week for six weeks, are shown.

1a. Scout Troop expenses assuming an eight-month period with 12 youngsters doing a different OBIS activity every other week.

One OBIS Trial Version Set I including postage	$ 8.75
Supplies to conduct 16 of the 24 activities with 16 youngsters each meeting	77.51
Total for 16 meetings, 1st year	$86.26

or $7.19 per youngster/8 months
or $0.45 per youngster per meeting
or $5.39 per meeting for all youngsters

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1b. Assuming a second 8 months of operation with this same Scout leader conducting the same activities with the same size group, etc., the cost breakdown is:

OBIS Trial Version Set I	$ 0.00
Supplies	25.65
Total for 16 meetings, 2nd year	$25.65

or $2.14 per youngster per eight months
or $0.13 per youngster per meeting
or $1.60 per meeting for all youngsters

The above figures are based upon current retail costs of the supplies needed with the assumption that even such items as rubberbands, paper clips, old springs, nuts, bolts, nails, etc. would be purchased.

2. Camp expenses, assuming six weeks of camp each with 60 youngsters and each youngster exposed to six activities.

OBIS Trial Version Set I, including postage	$ 8.75	
OBIS Trial Version Set II, including postage	10.50	
Supplies (6) (60) (0.405)	145.80	
Total expenses for 1st week for 60 youngsters doing six activities		$165.05
Expenses for each subsequent week	48.60	
Expenses for last five weeks	x 5	243.00
Total expenses for six weeks		$408.05

The above costs assume all supplies will be purchased from retail outlets. The multiple entry point concept in which the leader may do any number of activities in any order makes it possible for the expenses to be higher or lower. Other unknown factors such as level of material reuse, subgroup sizes, number of activities being used simultaneously, and the degree of material sharing by leaders, etc. will alter the costs slightly.

Training costs. Costs for training leaders vary but a workshop of one day duration is sufficient for leader training. The training of those who train other leaders can be done in one day but is best done over a two-day period. Actual workshop costs probably average $210 when handled by community group trainers on their own sites with their own people. This does not include any leader consultant fees but does include a set of printed materials for each of 15 participants. The cost with a set of 24 activities given to each leader then is $14 per participant. If participants purchase their own printed materials the cost per participant is about $5.00.

Obviously costs will be greater if sites have to be rented, and if transportation, food, or lodging are paid for.

Refill costs for participants. Supply refill expenses are about 33% of the original low supply costs. Purchase of new printed materials, other than duplicated activity cards, is not necessary. Refer to the two previous cost examples to see how costs for the second and subsequent uses are reduced. Of the 48 different activities now published about five require no refill material at all and another eight require so little (e.g. one bottle of food coloring) supply renewal that the cost per participant is less than $0.02..

Need for support services. Support services are unnecessary. Each leader once trained or self-taught, is autonomous and needs no further assistance other than to occasionally share some of his or her experiences and techniques with other leaders.

Comparative costs. In comparison with other activity-oriented programs which teach ecology (mostly in the schools) the costs to implement OBIS are extremely small. Community groups are typically hard pressed for funds so in order to have the program reach the children for which it is designed, low implementation costs are mandatory.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

Inputs from the public. OBIS is primarily developing materials for a wide variety of users drawn from the general public. The project is constantly concerned about obtaining feedback on its work from scientists, educators, community group leaders, and other members of the public. This information is obtained in many ways including but not restricted to: 1. Public presentations on the project at conventions of local, regional and national community, educational and scientific groups. 2. Requests for feedback from participants at all OBIS public presentations and leadership training programs. 3. The extensive use of knowledgeable individuals to review, comment upon, and make suggestions regarding present folios and areas in which they think new folios should be developed. As a program for the public, OBIS is constantly involved in a give-and-take with user groups and other members of the public.

Internal monitoring procedures of the project. The OBIS staff is made up of a primarily full-time group of research, development and support personnel for whom OBIS is a major professional concern. All members of the professional staff including the project administrators are involved in the design, development, and trial of new activities and approaches to outdoor biology. Since the activities (currently folios), which are the substantive output of the project, are the most important product produced, the following synopsis of how a folio is developed is presented to indicate the extensive commitment to internal monitoring of the output and quality of the project.

Process of Design and Trial of OBIS Materials. Each OBIS activity undergoes an exploratory, and a local trial phase during its development. The following idealized description of the two phases presents the operational approach to development used by the project.

Exploratory Phase. Using the OBIS Ecological Mosaic and other sources, a concept, technique and/or environment is identified as necessary for accomplishing the overall project objectives. Project staff members try out and evaluate these promising ideas with a group of learners available at the Lawrence Hall of Science, the University Botanical Gardens, and other local agencies. Based on these explorations and related library and laboratory research, early written versions of applicable activities are produced. Further testing with learners leads to complete versions of the printed materials and related equipment. This is the output of the exploratory phase and includes tentative folios and necessary specialized equipment and materials which a small number of leaders, not from the project staff, can further test in the San Francisco Bay Area. The exploratory phase for a given problem or environment will take from a few weeks to as long as six months.

Local Trial Phase. Exploratory folios selected for further development are tried in the San Francisco Bay Area by three to five non-project instructional leaders, drawn primarily from community groups who provide the project staff with feedback on what happens when an "outsider" uses the materials. During local trials significant modifications in scope, sequencing, and required equipment and materials may be necessary. Project staff carefully monitor these local trials using primarily direct observation as their approach. As a result of the feedback collected during the local trial, the project team reworks the activities to produce the trial versions of the folios and related equipment and materials. These trial versions of the folios are then made available to the interested public and will be further analyzed and modified after use more generally by the public and in the proposed trial centers.

Independent evaluation of OBIS. At the present time, independent evaluation of OBIS is pretty much restricted to the judgments made by community groups regarding the value of the materials in their own programs. Interest is high, use is extensive and growing, and at this level the external or independent evaluation of OBIS is highly positive. Considering the unique nature of the OBIS materials, and the fact that community use of such materials is an innovative approach, it would be most valuable to carry out an independent evaluation of the project, and OBIS would be happy to cooperate in such an evaluation. Groups have expressed interest to OBIS in carrying out such studies, but until now the problem has been obtaining funds to support such a study.

Provision of information to the public and NSF. The OBIS project is concerned with the community and the public in general. The OBIS project is most concerned to provide the public in general and the National Science Foundation in particular with as much information as possible through presentations at community and professional meetings, articles written for journals, the publication of the

OBIS newsletter and the making available of sets of folios to major university libraries and community organization centers. OBIS makes many efforts to keep the public informed of its work. The project offices and archives are open to the public, and many visitors to the Lawrence Hall of Science take advantage of the opportunity. In addition to all these items, progress reports, proposals, and other reports when requested are provided to the Foundation to keep it informed.

D. 11. c:OBIS (Panel 5): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The developers have investigated the field with respect to the availability of sound educational material for use by youth in community settings in the area of outdoor biology. Other materials which are educationally sound, environmentally significant, technically accurate, attractive and cost effective are limited in their availability. Exc~~iting mate~~rials for use in various community settings are not available in the form in which OBIS exists. Hence the panel feels that a definite need exists.

The efforts completed by the OBIS staff in the area of needs assessment seem most adequate. Panel members representing various community groups and school levels support the fact that there is indeed a need for "OBIS-type" instructional strategies.

The materials appear to be appropriate for all youth ages 10 to 15 as judged by the project staff. Panel members believe that the materials would be appropriate for younger people as well as adults. The one problem with respect to "reaching" youth groups exists as a problem of communication. A mechanism for calling the availability of the materials to the attention of youth and community leaders is needed. Funds for special workshops, awareness conferences, and other dissemination strategies will be needed if the OBIS materials are to realize their full potential.

Few instructional materials with the same characteristics are known to exist. With the vital environmental problems that characterize our modern society, the need for such exciting materials seems genuine and critical. The panel recommends that additional activity folios are needed and should be supported.

Question 2: Is there a market for these instructional materials?

Efforts have been expended in the private and public sectors to produce instructional materials designed to meet the needs of school and community to teach the total population about our environment. The impact that these materials have exerted in the trial areas is clear, and the response is positive. The project staff appears to have planned its attack in a logical and systematic way in order to educate the community outside of the classroom concerning the environment with which society must deal. The panel recognizes that this plan is a large and versatile approach to meeting the needs of this segment of the population.

Although OBIS is not aimed primarily at the formal school setting, certainly the materials are being used in school settings without requiring a reconceptualization of the curriculum.

It appears to the panel that although a large number of service and social organizations have received and used the OBIS materials, there is a large

segment of the total community that remains unaffected. For example, one might ask the question, "How many urban youths and/or minority youths are actively involved in 4-H club work and other similar groups?" It would appear that the dissemination plan should be strengthened to assure that youngsters in all settings have opportunities to use these materials. At the present time, it is necessary to create a greater awareness of the available materials and to provide a model for dissemination. Publishers may not readily provide these types of instructional materials because the folios should be inexpensive and consequently may not be profitable to a publishing firm. The panel doubts that continued use and dissemination of these materials will affect the publishing industry in a negative way.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The major goal of the project is the design of instructional strategies for outdoor learning activities in biology that can be applied in diverse environments. Activities of both independent and sequential design are used to promote an understanding of ecological relationships by youngsters from age 10 to 15. Approximately 200 activity folios are projected to provide wide activity choice among community and various school groups.

The materials may well be appropriate for students younger than age ten as well as various adult groups. The materials may also be valuable in providing youth and adult leaders with frequent opportunities for clarifying values. The panel recognizes that affective changes are expected outcomes. The panel agrees that the materials succeed in fulfilling the need (question 1) and in meeting the stated project goals. The goals and values are clear, the assumptions valid, and the rationale precise.

Although the instructional materials are diverse, they become unified in their applications, a goal seldom realized to this extent. The instructional materials are readily adaptable. The modular approach can provide completeness as well as variation and transportability. The modular approach allows periodic updating and improvement as new knowledge is discovered or new concepts become relevant to the instructional plan. The implicit and explicit assumptions are fulfilled in the material provided, thus making either the total package or a fraction thereof a cohesive one.

Question 4: Is the content of these instructional materials scientifically correct?

The materials produced to date are scientifically accurate and impressive. Since the instructional mode is non-traditional, student-oriented, and open-ended, there is ample opportunity for teachers and/or other leaders to encounter situations where accuracy of scientific content, information and explanation may be an important consideration.

The instructional materials are current, especially as they relate to problems of the environment. Since use of the materials is at the community level, it is important that activities are applicable in a variety of geographical areas. Although many folios are still being developed, the panel

has noted the specificity of certain activities for major use in restricted areas.

The content of the program is aimed at producing a more scientifically-literate population which is also environmentally concerned. The content of the program addresses itself well to these goals.

Although the discipline (outdoor biology) and the approach to it may seem restrictive, it is important to note the setting for the use of the materials and the potential for great impact and effect. Since the materials are largely unstructured and non-sequential, some individuals may be concerned with the lack of real penetration and biological rigor. The panel feels, however, that this criticism would be inappropriate in view of the target audience.

Question 5: Is the content of these instructional materials educationally sound?

The activities are challenging, diverse, potentially enjoyable, open-ended, and able to accommodate various needs of the target users. The individual and family, civic, social and religious groups can find much suitable material to use in a variety of ways.

There has been ingenuity in the development of the materials so that they are adaptable to a wide variety of learning and teaching styles. They can be effectively used by persons of diverse backgrounds and abilities. The activity approach makes the materials especially suitable for students with special learning problems. The project writers use value clarification techniques for developing and emphasizing environmental interrelationships. However, the structure of the programs provides sufficient material for the lay instructor or activity leader to competently approach the subject under study.

The content of these instructional materials, the suggested teaching strategies and the extensions of the instructional suggestions appear sound.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The following impacts of use of the instructional materials are ascribed to possible consumers:

Non-traditional educator groups are provided with an excellent opportunity for their lay teachers (those having little formal biological training) to grasp scientific principles and to convey these principles to interested members of the public in a variety of diverse settings. Students are provided an opportunity to develop exploratory activities leading to environmental understanding. Teachers are provided instructional packages that will assist the student in his educational adventures related to environmental topics. Depending on content, duration and impact of preparatory workshops, teachers have the opportunity to develop skills and provide improved instruction. School districts are provided opportunities to improve the effectiveness of their outdoor educational efforts.

If effective dissemination can be realized, the greatest impact may be made in the nonacademic, nontraditional education enterprises. Environmental awareness can be greatly enhanced by the OBIS materials only if sufficient efforts toward dissemination are achieved. Realization of the overall interaction of biological systems seems to be a prime focus.

Unintended effects are difficult to predict. However, responsible decision making related to the environment should be a positive outcome. Interest in and possible pursuit of further study by students may result as another outcome. The program cannot be used without active involvement with the out-of-doors. If youth leaders are adequately prepared, they can react with alternative environmental situations, and another goal will be realized.

Absolutely no biases or stereotyping are evident. Honest assessment of the outdoor activities will serve to illustrate the interrelatedness and interweaving of the environment. Indeed the recommended approach to the activities may help resolve biases and stereotyping. Obviously such activities and approaches can become controversial. Some members of the panel believe that the developers and the Foundation (NSF) should be aware of the potential for controversy. Members of the panel, however, applaud the approach and agree with the necessity for considering values and other topics about which all people do not agree.

Learning of biological principles as they relate to one's everyday life is an important process feature of the materials. An additional experience would be the development of a firsthand knowledge of man's effect on the biology of the environment. Attention should be called to the innovative application of ecological principles to man-made and architectural environments. The use of these common phenomena in the instructional strategy is still another outstanding feature.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

Though these materials are designed primarily for community groups, they can become a significant part of the science education programs of many schools. Classroom teachers can avail themselves of these materials as opportunities to relate their science programs to the environment of the local community.

Schools, administrators and teachers need to be made aware of the existence of these materials. Funds and special programs will be required for supporting implementation activities.

The costs for the program are minimal. They can be handled within an already existing structure for school budgeting.

There seem to be no barriers to implementation; on the contrary, the program is diversified enough to make it adaptable to school situations.

Some special considerations concerning the use of OBIS in schools include:

1) there should be coordination between school and community groups if the program is being used by both;

2) there is a need for outdoor activities for all parts of the nation and for all seasons;

3) in states where textbook adoptions must be approved, some attention will be necessary for using OBIS materials as structure for a course where no text as such exists.[1]

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

The project staff has estimated the cost at a maximum of 45¢ per youngster per meeting. This amount may be higher than some youth groups can afford. However, a number of activities which involve little or no cost can be implemented for groups with very limited budgets. The same comments apply to replacement materials.

In larger groups, such as camping situations, the option for higher cost activities may be important because of the possibility of amortizing the program costs over a larger number of students for a longer span of time.

The potential users could purchase some similar materials though frequently in book form. The costs of such materials are similar to the OBIS written materials although not in the same immediately usable form for youth. Many of these alternate materials do not allow for excursion and extension activities. The laboratory materials needed for some units may make OBIS slightly more expensive than other available materials if a preponderance of the more individual and expensive materials were selected. If club volunteer leaders must purchase materials with personal funds, they might be discouraged from using the materials.

Some volunteer leaders may encounter difficulties with the metric system. This problem could easily be solved by providing a short unit for volunteers on the metric system. As use of materials continues and as experience with community groups accrues, additional directions, suggestions and assistance may be necessary for instructional leaders. A general bibliographic list would also be helpful to lay leaders by providing additional information about the learning activities. An activity leader's handbook would assist in the adoption of the effort by leaders with a limited science background.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

There are provisions in the management plan for interaction with various interested parties. The involvement of scientists, teachers, curriculum innovators, community leaders, and students in the preparation of materials is applauded.

Field test teams were charged with internal monitoring. Advisory groups, frequent staff evaluations, and results of pilot use were adequate. There has been external evaluation, especially by would-be users.

The project has been neither administratively top heavy nor deficient. Project documents describing the program have been adequate for the Foundation and the public. As indicated previously, the developers may need to consider more awareness information and give more time to implementation efforts. Further preparation for the teacher-leaders may be needed since most volunteer leaders are not trained in outdoor biology study. The panel concludes that the management/organizational plan is both adequate and effective.

1) Additional comment by Sister Shirley Corbliss: "I believe it should read: In states where textbook adoptions must be approved, some adaptation will be necessary so that OBIS materials can be used as the structure for a course, since no text as such exists."

D. 11. d: OBIS (Panel 3) Individual Panelists' Responses to 10th Review Question

Question 10: What are your general impressions of the curriculum?

Panelist: Dr. Daniel F. Burton

Most educational agencies, local or state, have begun to question professional personnel about cost and effectiveness of programs. Shrinking enrollments, the slowing of national economic growth, resistance to taxes combine to give Congress, legislatures, and school boards the choice of cutting personnel, building, teaching materials, or some combination of these. To make choices of programs to cut or new programs to initiate, appropriation committees and boards need to know which programs or projects can be proved to have a positive value for students. The most effective way to obtain data on a program's value is to determine how students' skill level and/or attitude and/or behavior have changed as a result of participation in a program. NSF terminates its role just prior to dissemination which inhibits collection of such data. I recommend NSF budget for follow-up of disseminated projects to document successes (and to discover causes of failures, if any).

Panelist: Mr. Wayne E. Carlson

If people are to make intelligent decisions on management of their environment they must first understand that environment and how they as human beings fit into that ecosystem. The design of instructional strategies for youth in outdoor biology that can be applied in diverse environments is a laudable goal and one that is essential if people are to understand the effects of future decisions they must make regarding environment.

This is apparently the first time that NSF has funded a project which is designed for informal educational groups like Scouts, 4-H, YMCA, YWCA, Campfire, etc. This step is exciting because it reflects an acceptance of the important educational function that youth organizations outside the schools can and do perform. The public financing of such efforts is not inconsistent with 4-H since public funding is its normal mode of financing but may be a problem for other youth organizations who depend entirely on the private sector for its support. In the case of other youth organizations which largely depend on private funding, such efforts serve as a new source of resources.

Regarding the curriculum itself, I am very excited about the format and there are several features that are particularly attractive:

a. The flexibility allowed by the free choice of activities.

b. The use of and emphasis on the study of man-made environments.

c. The complete and concise instructions for use of the teacher or leader.

d. The attractiveness of the materials.

e. The relatively low cost.

f. The ease of program implementati n and training of leaders or teachers.

g. The recognition that ecological education can be learned in a "like-life" outdoor situation.

h. The existence of a very exciting program package for (especially) camping situations.

i. The opportunity to develop leadership skills by having teens lead 10-year-olds in this experience.

Some of the concerns I might raise are:

1. Extent and cost of lab materials. Volunteers may object to the inconvenience and cost of providing for or paying for lab materials. Volunteers may view this as an imposition and a waste of time especially if they do not do some pre-planning for lessons. Support organizations may have difficulty in maintaining supplies for volunteers too, if that choice is made.

2. Volunteers will initially object to the metric system. Many are and will be of an age where they may feel they are too old to learn a new system so there must be a conversion system to make the transition more bearable. If any other units are produced, can both be included?

3. More folios need to be developed. This is especially true for outdoor winter activities in northern areas. Can volunteers and leaders be encouraged to suggest exercises which they have used successfully? Some exercises are . t as readily usable, i.e., ocean activities inland.

4. This program is limited for the youth who wants to study on his own without leader help. He or she may not have access to individual packets for free choice study because each person would normally not be able to afford an entire package.

5. The assumption that ev- ything will fit together in a cohesive, logical, understandable order with or without leader assistance. Volunteers vary a great deal in background training and some may not be comfortable in designing and carrying out a logical sequence.

6. Possible overlap of use of these materials by both the formal school and the youth organization. This is not a serious problem because each experience will be flavored by the site chosen, i.e., different animals, insects, birds, critters, etc.

In general, this program is very well designed. National youth organizations should be contacted and introduced to the materials. Many are looking for new program materials in this subject area. All could work together locally in offering training for their volunteers and in sharing resources.

Panelist: Sister Shirley Corbliss

This program helps meet the great need for instructional strategies for outdoor environmental learning activities that can be used by groups with diverse backgrounds. The program is ~~especially~~ important because it applies these strategies to the man-made environments. While I am very enthusiastic about the program and endorse it, I would like to recommend that more activities be developed to deal with the urban environment, since this is our most extensive man-made area.

Panelist: Dr. Richard A. Dodge

OBIS represents an innovative and creative venture involving non-traditional educational consumers in a non-traditional educational environment. I strongly f[illegible] that the program will make a major impact in providing lay teachers and students with relevant experiences in their environment. The use of "manmade environments" as study subjects is particularly attractive. Scientific content and activities are proper and well implemented considering the indicated user population. While the scientific content tends to be superficial, this is expected and desirable considering the intended use. I strongly believe the target population is broad, extensive, and most appropriate. While commercial publication opportunities may be limited because of the low potential profit, I believe support of this material will be funds well spent to greatly increase public understanding of environmental issues, problems and investigative techniques.

The instructional items presented in evidence show careful concern for public education, need for social awareness, and creative development of materials. The awareness of current and developing educational pedagogies is apparent. The modular approach to activity development provides superb opportunities for widespread application under virtually all teaching situations. Thus, exportability and specific local needs can be satisfied by the OBIS program. Because of the open ended nature of the OBIS educational strategy, new and emerging instructional needs, topics, and evidence can be incorporated later at a very modest cost. Indeed, the approach can provide a stimulus and incentive to produce local programs using the OBIS plan as a model; thus the effectiveness could be magnified by many factors.

The approach to public education (of students and lay youth leaders) is particularly strong and useful. I see no difficulties concerning the social, religious, ethical, racial or scientific conflicts recognized in the materials reviewed. This could occur, however, if "packages" were to be developed in topics dealing with the above. I suggest a very liberal use of broad-based advisory committees in the formulation of future package topics.

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Panelist: Dr. Roger W. Hanson

This program is well conceived, sound in its approach, versatile in its applications, and superbly managed.

I can offer nothing more than what has been stated by the managerial staff and affirmed by the panel. I wish that I could offer suggestions for dissemination of materials but unfortunately I have none.

Panelist: Dr. Fred D. Johnson

The OBIS curriculum is an impressive project that has been well designed and appears to meet the needs of a segment of our population that may learn about the environment only through this medium. Most efforts that I am aware of are designed to meet the needs of students presently enrolled in school. I feel that this project would be a valuable asset to our nation if it were continued and revised in order to adequately educate the total population about the environment.

Another strong point about this curriculum project is that concepts are taught in proper perspective. The interdisciplinary nature of the environment is emphasized in these instructional materials. More interdisciplinary instruction is absolutely necessary if we are to educate a population that can cope with the many technological and ecological gains that have been made and problems which confront us as a result of these technological gains.

I feel that continued revision will be necessary based on feedback from the groups who are presently using these materials. Yet the materials are designed to be applicable in any setting; I would suggest that there may be problems that are unique to an area that should be taken into account as the revisions take place for various regions of the country.

In my opinion, the weakest aspect of the total project is the dissemination plan. Despite the sincere efforts of the project staff, based on the evidence that we have, I would conjecture that a large segment of the population has not been exposed to nor are they using these materials. It is imperative that all segments of our population be exposed to and encouraged to gain more knowledge about the environment.

Panelist: Mr. Andrew H. Miller

The OBIS program is as American as apple pie. It is a new approach to outdoor education that previously was conducted by the 4-H, Boy Scout and Girl-Scout programs. A definite need exists for more materials such as the OBIS package for the environmental education of American youth. The only thing noticeably missing in the program is an input line to the designers. An open line needs to be established for the uses of OBIS to suggest new programs to the creator. Overall, OBIS possesses tremendous potential and, if circulated by concerned volunteers, would provide a low cost, enjoyable and ultimately, effective environmental education effort for American youth.

Panelist: Dr. Gerald A. Myers

OBIS presents to the out-of-school 10-15 year old public an excellent set of materials for use in organizations whose leaders are not professional teachers but play a role as facilitator in environmental education.

I suggest that Lawrence Hall of Science publish and distribute the educational materials since expensive publication will lose the market potential.

More materials are needed for winter environment studies.

I feel this project was well conceived, meets a unique populace (middle school) compared to other grants by NSF, was efficient in development and had expertise at all levels of the program development.

Panelist: Dr. James M. Stevenson

Generally I am impressed with the nature and design of this product. The presented curriculum seemed adequate to accomplish the intended goals and in some instances promised to generate a new clarity to the understanding of natural and manmade environments and their interactions.

The values of the OBIS project cannot be quantified easily. Providing the opportunity for students to learn in an experimental manner alone represents recognition of fairly recent educational progress. The instructional materials have the added advantage of being useful to teachers and nonformal institutions alike.

In the dissemination of the material my suggestion would be that a coordinated effort be made to assure groups (i.e., Scouts, camping grounds, etc.) working together, sharing teaching resources to add yet another dimension to the project--mutual cooperation of various community groups.

Panelist: Mr. J. Howard Straiton

In my judgment the OBIS panel 5 review committee says it all; to add more would be an exercise in redundancy.

Panelist: Dr. Robert E. Yager

The OBIS project represents an exciting set of curricular materials for a wide variety of uses. The non-structured format, the possible use in a variety of settings, the cost effective character of the activities, the open-ended feature of the cards, the emphasis upon vital environmental issues are all features which are commendable and to be applauded.

The OBIS project is "right-on" with respect to curricular needs for 1976 and beyond. It would be difficult, if not impossible, for private publishers or educational groups to produce such instructional strategies without Foundation support. Exciting, needed, attractive, usable, sound, fun, financially-feasible are all correct descriptors for OBIS materials.

Panelist: Dr. Dean A. Zollman

The OBIS project is developing materials to aid a very important component of our educational system--organized, informal education. The materials produced so far seem easy to use, adaptable to many localities and inexpensive. I suspect that the folios will be very widely used. I hope that the project staff will develop as many packets as they can and include experiments which can be done on cold winter days and, if possible, rainy days.

D. 11. e: OBIS (Panel 6): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

1 A-B. Since 1973 NSF needs assessment guidelines have been expanded, especially in the composition of advisory panels, insuring a cross section of students, lay citizens, and representatives of broad political beliefs.

The initial needs assessment conducted by the OBIS developers concurs with the subsequent position reaction of the many national community groups toward the materials. Since 1973 OBIS has made a systematic effort to survey and interact with the variety of community groups on the local, regional and national level.

The reasons for this were three-fold. First, to find out the extent of community interest in a program like OBIS. Second, to get to know and understand the nature of community groups so that the OBIS materials could be designed more effectively. Third, to try out and obtain feedback by means of conferences, leadership workshops, and training sessions on the content and design of OBIS materials.

This interaction began with a survey and Community Group Conference on the local level and is continuing on the local, regional, and national level. During 1975 OBIS has carried out a workshop or other information and training program for leadership staff of the following groups: Boy Scouts of America, National; Girl Scouts of the U.S.A., National, Regional, and Local; State and Local Park and Recreation Districts; YMCA; University Environmental Centers and Departments; School Environmental Centers; National Jewish Welfare Board; American Camping Association; Camp Fire Girls; Salvation Army; National Park Service; 4-H, National, State, and Local; Junior League of Oakland.

1-C. Groups currently using OBIS materials represent a potential user population in the neighborhood of ten to fifteen million young people.

1-D. There are programs in existence which share the stated aims of OBIS, but are not fulfilling the community groups desire for stimulating programs in outdoor biology.

1-E. The need for OBIS materials might be increased by expanding them to include the observation of social phenomena of individuals and groups interacting with biological and social environments, hence interrelating the natural and social sciences.

Question 2: Is there a market for these instructional materials?

The panel studied OBIS project director's statement "Is there a market for these Instructional Materials?" and concluded that the statement should be incorporated into the panel report.

"The OBIS market. The primary market for OBIS materials is community groups and certain aspects of the school program such as school camps, after school clubs, and summer school programs. During the past few years a large number of 'environmental education' materials have become available. Many of the groups working closely with, and already extensively using OBIS, have produced materials of their own but have found them lacking for one or more reasons. The format, approach, and content of OBIS materials makes them highly marketable to community groups because they include the following important characteristics.

1. A basic concern with promoting an understanding of ecological relationships in the man-managed or disturbed environment.

2. A community group orientation which places OBIS in the realm of free-choice recreation activities.

3. Motivating entrance activities which are both fun and challenging to youngsters and leaders.

4. A discovery method approach to learning using hands-on, open-ended investigations.

5. Inexpensive materials are provided for use in investigating the outdoor environment in a format that does not threaten the untrained leader.

6. Materials can be used in diverse environments throughout the nation and can be integrated into already existing programs.

7. The materials are highly flexible and therefore can be fitted into existing programs or form the base of a new program.

8. The materials are non-threatening to leaders who have little or no background in science or education. Thus they feel they also can handle the program.

9. The materials are attractive and well organized, and therefore appeal to the user groups.

Other programs currently available in environmental education do not meet some or all of these criteria. Therefore interest in and utilization of OBIS materials is high and is growing.

"OBIS Dissemination Plans. The groups for whom OBIS is intended are highly individualistic, and although national in organization, depend on local and regional associations and boards for their actual support and operations. Budgets are limited and prior exposure to dissemination of materials has been through announcements in organization newsletters or 'new requirements' for participants. Neither of these approaches leads to a long-term intellectual or operational commitment to a program as evidenced

by the lack of growth of in-house environmental programs in many organizations now extensively implementing OBIS. The OBIS approach is to inform and convince national leadership of the value of OBIS and then to develop a plan for the trial, use, and internalization of the materials into the ongoing operations of the group. Depending on the organization and its nature, this can take a number of different approaches. For example, with the Girl Scouts it was deemed most advantageous to proceed on the local level with the San Francisco Bay Girl Scout Council (about 150,000 girls) as an exemplar to the national organization. Leadership training and feedback sessions have been held, use has been monitored, and, as concrete evidence of internalization, a special leader's patch signifying competence in OBIS has been designed and is currently available from the council. These developments have been observed and discussed with the national organization and plans are currently underway for expanding the use of OBIS in Girl Scouts on a national level.

"With the American Camping Association (the professional National Association of Public and Private Camps) on the other hand, the emphasis has been on working with the national group and their affiliated regional ecological trainers. Supported cooperatively by an NSF implementation grant to ACA, OBIS has participated in the training of these leaders in the approaches of the project and they in turn have provided leadership training in OBIS to counselors and other camp staff as a regular part of their ongoing service to ACA. Interest in the materials and their use has been so successful that currently discussions are going on relative to designing and making available a special ACA version of the OBIS materials which would then become a part of the organization's program recommendations to its members. As can be seen from even these two examples, dissemination of OBIS is a complex but rewarding task which will require some external support but can depend extensively on the ongoing operations and staff of the user groups. Essential to this effort, however, is the maintenance of a high degree of flexibility in the format and availability of OBIS materials.

"Market Response to OBIS Trial Materials. It is important to note that OBIS is not only entering a market, but to some extent is creating one. That is, community groups and others involved in informal education are not used to having materials prepared for them by outside agencies (especially funded research and development groups) and, therefore, the marketing of OBIS materials is as innovative an approach as the development of the materials themselves. Previously, the typical marketer of educational materials has been the publisher and these individuals are not used to (nor should they be) calling on the local scout troop, recreation center, or summer camp.

"A good indication of the market interest in OBIS materials is given by the history to date of the production and distribution of OBIS Trial Edition Set I. The first production of these 24 folios was

completed in June 1974. Two thousand sets of folios were produced and since these were considered trial versions, no effort to promote their sale was made beyond announcing them in the newsletter and making samples available to OBIS Field Centers and at workshops. It was estimated that this production run of 2,000 would meet public demand and project needs for 1½ to 2 years. Six months later, in January, 1975, the supply of folios had been exhausted. Reprinting, with some revision based on feedback received, took place in February 1975.

"It is interesting to note that in the distribution of the first, 5,100 OBIS packets, about 4,750 were sold and 350 were distributed free for project purposes. About 30% were sent to individuals in schools or school systems while over 40% went to leaders of community groups. Another 20% were distributed to colleges and universities where one can assume they will be seen and used by both school and other community environmental education groups. This rough breakdown indicates that OBIS materials appeal to a wide variety of community and school groups.

"There is significant interest in OBIS and a major market for the output of the project. Final distribution plans for the materials will have to evolve out of the current experience in marketing the trial versions."

Question 3: Do these instructional materials possess a clear purpose and rationale?

The "Leader's Survival Kit" and the folios examined do not include information on purpose, rationale or instructional strategy for the OBIS materials. The proposals submitted to the NSF, the Project Director's communication to the review panel, and the 1974 trial edition of "Approaches to OBIS: Outdoor Biology Instructional Strategies" specify the goals and purpose of the materials, the rationale used in planning the OBIS project, and guidelines to the use of the OBIS folios.

The primary OBIS resource for the person (leader) who plans to use the OBIS folios is the "Leader's Survival Kit" which lists the folios available and three "modules" that can be prepared by grouping six or seven folios, e.g., (1) Adaptation, (2) Sampling, (3) Pond. The effective use of these modules depends primarily upon the leader's ecological knowledge, familiarity with capabilities of the children, and ability to interpret the local out-of-doors situations to children. The publication "Approaches to OBIS" will assist the leader in making effective use of the folios and modules. The folios and modules are designed exclusively for group leaders, not for children.

It is intended that folios can be grouped to form "Habitat Modules", "Concept Modules" or "Technique Modules." The "Approaches to OBIS" would be much more useful if expanded to include more extensive guidelines to aid teachers in using folios, rationale for preparing modules out of a variety of folios.

Question 4: <u>Is the content of these materials scientifically correct?</u>

The OBIS materials appear to be scientifically accurate; the panel uncovered no factual errors. These materials certainly address topics which are current within the scientific community and are of popular interest.

The project is directed toward increasing the scientific literacy of the population, and incorporates mechanisms to reach its target population rather precisely. The target population is composed of the leaders of activities in non-school community groups which are already interested in conducting outdoor activities.

The OBIS experiences deal with ecological aspects of biology and closely related disciplines, taking advantage of familiar surroundings which may not yet have been viewed with the perspective found in the OBIS materials.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

5-A. Although the OBIS materials were not developed specifically for curricular program use, there are many school-adaptable components in the program. Most schools are interested in expanding their site and moving the learning experience out of the confines of the traditional classroom. This is especially true in elementary, middle, and junior high schools. The OBIS materials present an effective means of enriching a science program through ancillary use. More favorable than this school use, however, is the instructional value of the folios to the non-school population as well as to school-aged children in their extra-curricular pursuits.

Negative responses to the materials could originated from the non-environmentally concerned, from feminists who will object to the use of "man-made environment" (although if they were wise, they might leave this to <u>his</u> credit), and from individuals -- parents and/or children -- who dislike direct contact with the earth and some of its inhabitants. Some panelists found the materials to be simplistic and some reviewers may also note this. The negative environmental impact of OBIS's encouragement of "foraging" in the outdoors by large numbers of young people must be minimized by repeatedly printing reminders throughout the folios that the area in use should be returned to its original state at the completion of the day.

5-B. The content/approach of the OBIS program indicates a keen awareness of the cognitive, affective and psychomotor abilities for the target group. Children and adults with special handicaps and

learning disabilities can still learn effectively, since one of the most meaningful ways to learn involves use of all the senses in a direct hands-on experience. The special appeal of the program, greatly unique, is its potential to be used by group leaders with little or no formal education in either science or pedagogy. Interest, an ability to read and stamina would seem to be the major-requisites for a successful instructor. The advantages of leader training, including actual experience of OBIS sample units, should be emphasized.

5-C. Children who dislike an outdoor experience should not be forced, but rather should be encouraged into participation in an OBIS unit. In addition, children with special handicaps that involve safety liability should not have to participate in this type program beyond their parents' willingness to assume responsibility for the risks that any outdoor experience might involve. The OBIS concept is particularly effective for those children anxious to learn by seeing, by touching, by doing -- by being involved.

5-D. The OBIS materials treat values only implicitly, but one would hope youngsters using the materials would explicitly engage in value areas such as working together successfully, appreciating environment, respecting others, enjoying the natural environment and reenforcing the exciting results of informal learning.

5-E. The OBIS materials might be expanded from observing only natural science phenomena to observing also the social science phenomena of individuals and groups interacting with the biological and social environments.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

6-A. The OBIS materials are geared toward community and organizational use rather than toward school science classes. The objective is to offer aid to these consumers who are engaged in planning, for example, outdoor activities or camping projects.

6-B. The panel believes that for out-of-school training (4-H, YMCA, YWCA, summer camps, etc.) children in the age group 7-15 could benefit from the use of OBIS materials. (Note the reservation on the upper age limit for which OBIS materials would be meaningful as expressed by two of the panelists in the reply to question 6-C, however.) The OBIS materials could possibly be used as background material for group leaders for an even wider range of ages, as well in more direct use in classroom situations. Two effects that might be anticipated from the use of these materials are: (1) providing help for time-

pressed volunteers who might welcome a "package" rather than having to dig for materials; (2) providing an optional biology-oriented program for camping projects.

6-C. An important class of learning situations which can make profitable use of the OBIS materials are those involving exceptional children and adults because of the wide spectrum of sites, manual skills, etc., which can be employed for meaningful participation in the activities.

It seems that one of the advertised uses to which the materials would be put is decidedly off the mark for some cases. This would be in appealing to non-exceptional 12-15 year olds in outside school situations. Two panelists feel that there is little chance that the OBIS materials would be used successfully by Scout, 4-H, YMCA, inner city groups, FFA, etc., in 12-15 year old training programs; this arises not only from a mismatch of most of the projects to childrens' interests at these ages, but also from the desire on the part of these adolescents to avoid classroom-like learning during their free time, when they may prefer individual-type skills (hiking, swimming, canoeing, baseball, cooking, etc). Since OBIS materials are designed for leaders of groups in out-of-school study of biology, the young people participating in the groups may develop an increased interest in science. A second unintended effect could be the use of these materials as ancillary aids in a school biology class.

6-D. The panel believes that the content and approach of these materials is fair and free of bias. (See the comment in the reply to Question 5-A, however.)

6-E. For the younger children, especially, in all settings, the most important process feature would be simply stated in the idea that <u>learning is fun</u>.

6-F. It would be of great value to know the opinions and/or field test reactions to date from teachers and out-of-school leaders in making these judgments.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

OBIS materials are such that training of leaders need be only minimal. Extensive workshops for permanent supervisory staff of user organizations are desirable. However, an advantage of OBIS' simplicity is the ease with which these permanent staff can familiarize short-term volunteer leaders with the materials and their use. It is felt that use by individuals already familiar with outdoor education will require no additional preparation. Supportive reference material should be suggested within each

folio to assist those leaders unacquainted with outdoor taxonomy and ecological principles.

The use of OBIS is not likely to present serious conflict with existing organizational structures. However, there may be some formal school management patterns which may impede the usage of the outdoors as a laboratory. In such cases, OBIS materials may become leverage for overcoming these situations and furthering the outdoors as one of our most valuable educational assets.

OBIS cost factors appear to be realistic and minimal, thereby presenting no significant barrier to the program's implementation. The only elaborate learning resource that OBIS demands is the outdoors. Expendable equipment is inexpensive and of the type available in homes and schools.

Since OBIS materials could be used to supplement and enrich school science programs, they already represent an option. Schools which chose to use the material would not be establishing additional classes, merely alternative activities. With non-school groups the nature of the affiliation usually indicates shared interests, so the group should be interested in pursuing the same activity. A strength of the program is that values are not inherent in the activities themselves, but rather that the individual experience of the activity permits value clarification.

In organized school situations the only barriers to implementation would be those imposed by the nature of the school site and its relation to usable and varied outdoor resources. Field trips could provide opportunities for effective OBIS use. This cost could well limit some school districts' use of the materials unless funding was available. Since the design of the program, however, was not intended for school use, its value is in the enrichment area. School districts should be aware of their budget opportunities or restrictions regarding enrichment.

Question 8: <u>Are the cost for implementating these instructional materials reasonable?</u>

We believe that the cost estimate developed by the OBIS staff are both modest and reasonable. We wish to point out, nonetheless, that unless some of the potential user groups, e.g., inner-city scout troops, find a benefactor even the modest costs associated with use of OBIS will prevent their participation. We also believe that activities already being pursued by certain groups (Merit Badges, 4-H projects, etc.) make it possible for some of the objectives of the OBIS Program to be reached without use of the OBIS materials.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

Continuing interaction between the OBIS staff and the target population began before the project and has been encouraged by project activities such as presentations at meetings of community, educational, and scientific groups. The diverse nature of these groups provides considerable variety of viewpoint.

The materials themselves show evidence that referring drafts to knowledgeable individuals has been successful in eliminating errors.

There is no massive organization involved, and the success evident in the materials demonstrates that there are no appreciable problems in operating the project.

We have no reason to question management and organization from the proposal and from the November 21 memorandum from the project director.

D. 11. f: OBIS (Panel 6): Individual Panelists' Responses to 10th Question: What are your general impressions of the curriculum?

Panelist: Dr. Ted F. Andrews

The OBIS folios are primarily "teacher-leader aids." The science content in the folios is limited in scope. Examination of folios "Food Chain Game", "Water Breathers", and "Invent an Animal - Adaptation" did not reveal any errors in science information. The biological and ecological information in "What is OBIS?" and in "Approaches to OBIS - Outdoor Biology Instructional Strategies" is accurate and written at a level that is comprehensible by leaders of outdoor study groups.

OBIS modules (groups of related folios) suggested in "Approaches to OBIS" are: (1) Introduction to the Outdoors, (2) Sampling (Data Collection), (3) Lawn or Grassland, (4) Pond, (5) Forest, (6) Vacant Lot, (7) Stream, and (8) Environmental Impact. Additional guidelines for teacher-leaders would enhance the potential effectiveness of the folios and modules.

The OBIS Tool Box contains a variety of equipment and technique cards that can be used by "teacher-leaders" and participants in the activity. The cards are designed so that copies can be made and distributed to participants whenever feasible. In "Approaches to OBIS", a section called "Some practical considerations" deals with safety, care of living things, site selection and a variety of other topics. This is a helpful section, but needs considerable amplification in order to improve the use of the folios.

The OBIS materials include value-laden statements and inferences about preservation of the environment and the role of people in managing the environment. But extreme positions are not taken and value statements are usually supported by biological and ecological background information.

Although the developers of OBIS state the folios and modules are intended to give "...young people between the ages of ten to fifteen years the experience of observing and investigating organisms and events in the out-of-doors", it is my opinion that most of the materials can be used with most any age-group if a competent and effective leader manages the activities.

In this reviewer's opinion, "Approaches to OBIS: Outdoor Biology Instructional Strategies" should be greatly expanded, but dedicated primarily to OBIS as a system for enhancing outdoor biology education. Further, I would encourage the project directors and staff to develop a leaders-guide for each folio and for a few modules. The success of the folios and modules in involvement of people in good outdoor biology activities is so dependent upon the role of the teacher-leader that more background information on strategies and procedures is needed. There are numerous high quality "field guides" and other references

that both "teacher-leaders" and group participants could use. Selected, annotated references should be in each folio.

In this reviewer's opinion, the OBIS materials have the potential to meet a genuine educational need in outdoor biology external to formal education in the schools. In addition, the OBIS staff may want to consider development of some folios especially useful by "teacher-leaders" working with groups of senior citizens.

Panelist: Dean Elwood B. Ehrle

My general impressions of the OBIS Program and materials is moderately favorable. I believe the OBIS materials can be used and will be useful in certain limited situations. My experience as a Boy Scout Merit Badge advisor, along with my experience with my three sons, however, suggests that 8-11 is the proper age target group for OBIS not 10-15 as the project proposes. I have seen the equivalent of the "Great Steamboat Race" played in gutters by 10-year olds. Older youngsters will be turned off by what I feel they will intuitively perceive as a "Mickey Mouse" approach. The "Invent an Animal" game is as old as man's imagination and worthwhile in and of itself. It is best played spontaneously and without conscious purpose. It is possible that in attempting to make a "learning experience" out of it one gets neither learning nor enriched experience. It is possible that at the hand of pseudo-sophisticated youngsters one gets boredom instead.

I am also concerned that organized activities regularly occurring in Boy Scouts, Cub Scouts, 4-H, FFA and other groups may diminish the need for OBIS. These activities have gone on and will continue to go on with or without OBIS.

It does not appear to me that the OBIS program reflects nearly three-quarters of a million dollars and a three year effort. Since the program is so far along, however, I would recommend that it be fully funded to completion.

Panelist: Mr. William E. Galbraith

No comments submitted.

Panelist: Dr. Roger M. Herman

It is the purpose of the NSF, as I see it, to aid in the development of materials for education which could not otherwise be developed within the private sector of our economy. It is the opinion of this panelist that ample resources for the type of development represented in the OBIS program are available within service groups such as scouting groups,

4-H, YMCA, YWCA, etc., and that accordingly projects intended to fill these types of needs should henceforth be excluded from NSF funding. The service groups, such as the o[illegible]s mentioned above, have traditionally revised and updated their materials (although perhaps not always with a uniform degree of success) on a reasonably continuous basis, which again speaks to the lack of a need for federal funding.

My personal feeling is that the costs of OBIS development are somewhat excessive, in view of the fact that many of these types of activity are already in service group literature. For example, my experience as a Cub Scout leader indicates similar types of projects being sent to those leaders on a monthly basis. (How to build a bird feeder and observe the birds which come to feed is an example which comes to mind.) While not being an OBIS project to date, this type of activity, nonetheless, seems typical of OBIS type projects.

Finally, I would say that the belief that the OBIS program will be of interest to nonexceptional children (especially boys) in the 12-15-year-old age group in out-of-school activities represents an appalling misjudgment of human nature at this age. Imagine a group of boys at age 14 (whether from the inner city, suburbs, rural setting, small town, etc.) being content to search for imaginary animals, represented by toothpicks which were pre-placed in a lawn to represent the distribution of animals in their habitats! (of the OBIS Sticklers activity). To be fair, I may have picked on the most blatant example, but many of the other activities demonstrate a similar mismatch of intended usage and what common sense dictates would be the actual usage.

Panelist: Dr. Hilliard Jason

No comments submitted.

Panelist: Mrs. Elaine W. Ledbetter

I feel the OBIS materials represent an innovative approach to a type of outdoor education which is needed. With the current concern about ecological problems these kinds of activities for youngsters should make the coming generation of adults more aware of the natural environment and the necessity to protect it.

The fact that the preliminary printing of OBIS folios was so quickly exhausted by public demand to utilize them indicates the need for these kinds of materials.

In descriptive literature, I recommend that in addition to what is presently advertised about the use of OBIS materials, it also be noted that there are a great variety of situations in which they can be used--for example, extensions of classroom activities.

Panelist: Mr. Kevin McMahon

I am impressed favorably by the OBIS program's goal to raise the scientific literacy of its user group. I am bothered by the lack of included information, directed to the group leader, which deals with the purpose, rationale or instructional strategy for the OBIS materials.

I feel that the ends to which the program activities are aimed should be spelled out to the users. This would come from a group leader who has a strong understanding of the basic concepts of ecology and is able to understand how the activity could best achieve that understanding. The design of the OBIS program is valuable in providing the opportunity, in diverse environments, for the articulation of the leaders understanding, and valuable in providing the users opportunity to actively respond.

I recommend that the program proceed on lines which will provide more information on the basic concepts of ecology in the "Leader's Survival Kit", along with the stated purpose,rationale and instructional strategy for the OBIS materials. The knowledgeable leader provides the floor from which the "active-learning" design best attains the goal of greater scientific literacy of the user group.

Panelist: Mrs. Mary C. O'Brien

The OBIS curriculum adequately addresses itself to its primary objective - "to design instructional strategies for youngsters in outdoor biology that can be applied in diverse environments." Although the initial project was developed and field-tested in California, the concept has been expanded to cover such differing environments as Arizona and New York.

Consumers using OBIS materials are primarily groups oriented to outdoor activities - 4-H, F.F.A., camping groups, etc. There is feedback evidence that the project is successful and growing. As of November, 1975, forty-eight different folios had been developed to meet the needs and enrich the program. People today, in and out of school, are interested and concerned in ecology, and this project brings the basic concepts of ecology into focus.

Time-pressed volunteers should welcome OBIS because there is a scarcity of materials designed specifically for the "outdoor" classroom. To use OBIS materials the community or camp leader need not be a scientist nor an educator. The project is designed to help individual and group leaders to make their task easier and less time-consuming. Its value to community groups was summed up well on page five of the Lawrence Hall Summary, with two items having particular appeal: "Inexpensive materials are provided for use in investigating the outdoor environment in a format that does not threaten the untrained leader", and "The materials are attractive and well organized, and therefore appeals to the user groups."

There is a great deal of information supplied relative to the monitoring, field-testing, and feedback on the project. Especially important was the fact that community groups were involved in the testing. It was emphasized that non-staff members were a part of the overall evaluation process.

The validity of the age range (10-15) was challenged at the work session. With the abundance of field testing being done, and feedback being tabulated, that problem (if it exists) should be resolved.

I see the costs as a minimal problem. Indeed, for some of the projects all one needs for a laboratory is the outdoors itself. For the schools, which might well use these materials for planned field trips, camping projects, the costs would be nominal, comparatively speaking. Wider dissemination directly to the schools might be advantageous, especially since, through the indirect approach, "the number of identifiable school personnel who have purchased packets of OBIS Set I Materials is about 30% of the total number of orders received." This would surely indicate a wider school market.

Today there is a great surge toward improving the quality of life for the handicapped. More and more are pursuing the activities of the so-called "normal" person. Camps are now planned for the mentally retarded, the physically handicapped, the arthritic, the asthmatic and even for multiply handicapped persons. One suggestion would be to develop additional modules for these groups. Obviously some folios (Habitat, Sun Prints, Mapping a Study Sight, Bean Bugs) have been used successfully, but further development along this line seems indicated.

Finally, a project of this kind may well help some youngsters to overcome their fear of science, and begin to regard science as an interesting, useful activity that will both fulfill a need and enrich their lives.

Panelist: Dr. Marie Parnell

The OBIS program provides appealing and potentially exciting informal learning experiences for young people in non-school settings. As a packaged program it has the attraction of having been developed for group leader training rather than for individual student use.

Although the program was not designed as a school curriculum, it has many exciting possibilities for science teaching in elementary and middle schools particularly. Younger children enjoy the direct hands-on approach; combine this with taking them outside their usual classroom situation and they can begin to regard learning in more meaningful and enjoyable ways. OBIS provides for both these experiences. Equally important, elementary science teachers often don't command the degree of science preparation typically found amongst secondary science faculty. The design of the OBIS materials will permit them to include topics and experiences for their classes which they might otherwise not feel comfortable in handling.

The flexibility of the strategies also allows for a broader use of the materials than the project designers considered. Depending upon the skill and the background of the leader or teacher, the materials can be used with a wider age-range than intended in the original design. The response to the program already by schools and non-educational groups indicates the need for both the topics and the approach.

A very positive feature of the program is the opportunity it affords the individual child to experience his or her environment and to formulate a personal value considering his or her relation to it. Since the activity is done with a group, it further affords the opportunity to understand the social response of the human being in and with the environment.

This reviewer sees strong use of the OBIS materials in elementary science programs and would urge that the project be broadened to include these particular instructional needs. Many individualized science packages for classroom use are available to elementary teachers; few, if any, outdoor group materials are available. The OBIS program should be widely publicized to schools as well as to youth organizations.

One recommendation would be that a needs assessment be conducted prior to a project proposal. The need is not questioned; merely the sequence.

Panelist: Mr. Albert L. Powers

The OBIS curriculum, while not unique in content, is distinctive in its format and target population. The folios are designed attractively and are written in a nontechnical fashion thus avoiding rejection by group leaders unacquainted with outdoor biology.

Concern about the suitability of these materials for older youth (12-15 years) has been expressed by members of the panel. However, OBIS provides a quantity of very worthwhile activities and approaches not normally part of the repertoire of volunteer group leaders. Although the method of implementation of these activities and the complexity of the conclusions which they generate will depend extensively on the mental and social maturity of the groups using them, it is the opinion of this reviewer that OBIS has potential for all ages from 3 to 80+.

A serious omission from the packaged curriculum is a list of references to which users may turn for assistance in handling questions concerning the more sophisticated aspects of field biology such as taxonomy. It is suggested that such a list be included. It would also be highly desirable to insert a repetitive statement reminding users to return their working site to its original -- or improved -- state before leaving it.

Panelist: Dr. Howard Stein

I am delighted with the OBIS folios. They satisfy a strong need in the community -- a need of which I have been aware directly for several years. They further are conceived in the spirit that learning the principles of science can be fun.

The user of these materials will not be restricted to the particular target group identified by the OBIS personnel. Although the project focuses on non-school users, there undoubtedly are many schools in which short field trips are or could be used to supplement classroom instruction. Teachers in these schools may very well find that OBIS folios are the best sources of ideas for conducting these field trips.

In evaluating these folios one must keep in mind that they propose activities which need to be modified somewhat to suit season and location. The individuals (teachers, group leaders, etc.) who use the folios will, in most cases, require additional supportive materials or personal experience in order to cope with the natural curiosity of the children being instructed.

It would therefore be advisable for the OBIS staff to add reference lists to the folios. For example, a folio which suggests activities related to identification of organisms should -- indeed must -- include references to simple, appropriate field manuals and keys. There is a vast supply of such support material which is inexpensive and/or which often is available in local school or public libraries.

The success of implementation depends almost completely on the effectiveness of the people who act as instructors. They are thus the potential weakest links in the OBIS strategy. Efforts to educate the instructors in the use of OBIS folios are worthwhile. Part of this can be accomplished by beefing up the materials given to the instructors. Specifics on each folio such as theoretical background and expected outcomes would be helpful. I can imagine that colleges or adult education programs in a given metropolitan area could design courses for these instructors and offer them without any federal subsidy.

I am aware that some of the panelists criticize the project because they believe that the age level specified by the OBIS staff is too high. This is perhaps an unimportant point because the products will be selected for varying age levels depending on the nature of local groups and differences among the folios. I am suggesting that the folios represent primarily idea packets for instructors, to be modified to suit age levels, locale, etc. Also I am emphasizing that the OBIS folios most often will not be used as a unit.

Panelist: Dr. Roger K. Wangen

From a point of view of a global citizen and an educational consultant who perceives global problems as interdisciplinary phenomena, I find the Outdoor Biology Instructional Strategies a constructive set of materials for expanding young peoples' awareness of their natural environment.

OBIS materials approach values in an implicit manner but provide for individuals to explicitly clarify one's own values while interacting with the materials. One might infer that OBIS does value young people interacting with young people, young people working and learning constructively together, and appreciate, respect, and understand one's environment to name just a few.

The content selection for the consumer group identified is a most difficult task. Only experienced perceptive educators, who have long experience with students, other educators, and organized youth groups like the OBIS staff could have developed this broad ranged flexible content.

The author's approach of developing explicit materials for instructional leaders is desirable for informal community-based studies. This approach does not discriminate against young people who do not read well, making OBIS unique. The approach, however, will permit the use of the materials as supplementary in a traditional school; basic materials in a more informal or alternative school as well as basic materials for a community-based group interested in informal learning activities.

I have two suggestions for the staff. The materials would make a greater educational contribution if the authors would suggest that students acquire, organize, evaluate, and report on social interaction between individuals and groups and individuals, groups and their environment.

A second suggestion would be to "discover" words not perceived as sexist in nature. "Man-managed environment" might be changed to "people-developed" or, better yet, raise the sexism challenge with young people and solicit their ideas.

D. 12. a: HSP: NSF Descriptive Information

PROJECT TITLE: Three-Year Integrated Human Science Curriculum for the Middle Schools (HSP)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Norris Ross (as of 9/75)

INSTITUTION: Biological Sciences Curriculum Study Co., Boulder, Colorado

BUDGET: Total Granted: $1,782,940

Dates: 10/1/72 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: The Human Sciences Program (HSP) is developing a new three-year interdisciplinary curriculum designed specifically for the intermediate grades. Subject matter is drawn from the biological, social and behavioral sciences.

PROJECT SUMMARY

OBJECTIVES

To develop a new three-year interdisciplinary curriculum for the intermediate grades. The subject matter will be drawn from the biological, behavioral, and social sciences.

ACTIVITY PLAN

First Period March 71-September 72	Second Period October 72-September 74	Third Period October 74-September 76
Plan and conduct three curriculum framework conferences.	Test pilot modules in grades six, seven, and eight.	Produce and test seventh-grade materials.
Prepare preliminary program objectives.	Publish program rationale.	Plan, develop, produce, and test eighth-grade materials.
Plan, develop, and produce three pilot modules.	Plan, develop, produce, and test sixth-grade materials.	Prepare teacher's guide for the three-year program.
Prepare preliminary rationale and curriculum framework statement.	Plan and develop seventh-grade materials.	Revise demonstration module.
		Revise seventh-grade and eighth-grade modules.
	Prepare and produce demonstration module.	Prepare Human Sciences program information.

ORGANIZATION AND MANAGEMENT

Project Direction

Project staff - General direction of the project in all its details is handled by Mr. Norris Ross. The day-by-day operational responsibility rests with the Project Director, a Teacher Associate, three full-time consultants and an evaluation consultant. The principal staff members are assisted by a support staff which provides secretarial and clerical services, financial management, art work, design and editing.

Advisory Committee - The project has an advisory committee whose membership is rotational. Current members are listed below. The advisory committee provides consultation, reviews materials, and meets with the writing teams to review specific plans for modules.

HUMAN SCIENCES ADVISORY COMMITTEE MEMBERS
1973-1976

Paul DeHart Hurd, Chairman
School of Education
Stanford University
Stanford, California

Paul J. Bohannan
Department of Anthropology
Northwestern University
Evanston, Illinois
(1973-1974)

Jack L. Carter
Department of Biology
The Colorado College
Colorado Springs, Colorado
(1974-present)

Thomas J. Cleaver
College of Multidisciplinary Studies
Division of Education
University of Texas at San Antonio
San Antonio, Texas
(1975-present)

Lewis Dexter
Department of Political Science
University of Maryland
Baltimore, Maryland
(1973-1974)

Marvin Druger
Department of Biology and Science Education
Syracuse University
Syracuse, New York
(1974-1975)

Richard D. Mase
Department of Social Studies
John Adams High School
Portland, Oregon
(1975-present)

Patrick Milburn
The Center for Integrative Education
New Rochelle, New York
(1973-1974)

F. James Rutherford
School of Education
New York University
New York, New York
(1975-present)

Peter Scharf
Moral Education Center
Harvard University
Cambridge, Massachusetts
(1973-1975)

Harry Wolcott
Center for Educational Policy Management
University of Oregon
Eugene, Oregon
(1974)

UTILIZATION PLAN:

1974 - 5 Information Conferences
7 Resource Personnel Development Programs
1 School System Project
2 Teacher Centered Projects

1975 - 7 Information Conferences
7 Resource Personnel Development Programs
1 School System Project
2 Teacher Centered Projects

These totals do not include any dissemination center or field test site activities.

HISTORY

~~In~~ late 1966 the Biological Sciences Curriculum Study submitted a proposal to the National Science Foundation for the development of guidelines for a modern instructional program in the life sciences for the middle grades. The project was funded in early 1967 by the National Science Foundation. William V. Mayer, Director of the BSCS, and Jack L. Carter, former Associate Director of the BSCS, assumed responsibility for its conduct. Visits were made to schools in various parts of the country to talk with teachers and school administrators about their life science programs and to visit science classes in those schools. Teachers, science supervisors, biologists, science educators, and principals were identified for participation in a series of conferences to consider specific curriculum and instructional problems and make recommendations on a middle schools program.

Five conferences to develop recommendations for a life science program were held in Boulder, Colorado between November 1967 and June 1968. Several college and university professors of biology and of education, secondary school administrators, and middle school teachers were invited to attend. A sixth meeting of selected participants from earlier conferences was held in November of 1968, to summarize the recommendations of the conferences. In 1969 Dr. Paul DeHart Hurd of Stanford University prepared a summary statement of the conference recommendations as a set of guidelines published in BSCS Newsletter 34, April 1969.

The full report of the conference was published in BSCS Special Publication Seven, Life Sciences in the Middle School.

A proposal to initiate the development of curriculum materials for eleven- to thirteen-year olds, consistent with the guidelines, was submitted to the National Science Foundation in 1970. The long-range plan described a five and one-half year project for planning, development, production, and classroom testing of curriculum materials, following the guidelines previously developed.

PERSONNEL

The Project Director, Mr. Norris Ross, received the B.S. in Biology and Mathematics in 1964, and the M.S. in Cell Biology in 1969. He was a high school science teacher from 1964 to 1972, and has concentrated on curriculum development since that time.

D. 12. b: HSP (Panel 5): Project Director's Response to 10 Review Questions

Question 1: Is there a genuine need for these instructional materials?

A. What are the project's efforts at needs assessment?

Needs assessment began in late 1966 with the development of a proposal to prepare guidelines for a modern instructional program in the life sciences for those grades between elementary school and secondary school. This guidelines proposal was funded in early 1967 and involved an extensive series of visits to schools throughout the United States. It included interviews with teachers and school administrators and visits to science classes. These initial visits were followed by five conferences that took place between November 1967 and June 1968 involving junior high school science teachers, science supervisors, college and university professors of biology and education, administrators, and others in the field of science education. A sixth meeting held November 1968 resulted in BSCS Special Publication No. 7 entitled "Life Sciences in the Middle School" which appeared in 1969. In addition, a statement of the conference recommendations as a set of guidelines was first published in BSCS Newsletter No. 34 in April of 1969. These two documents fairly summarize the extensive needs assessment conducted prior to the initiation of a proposal for developmental activity.

B. Are there any other documented and/or generally accepted needs for these instructional materials?

See Item A above. In addition, a documented approach to adolescent education was published in 1973 by the BSCS that deals extensively with historical development and the more theoretical considerations underlying the Human Sciences Program. In addition, it provides additional readings, the three most critical of which are:

Inhelder, Barbel and Jean Piaget. 1958. The Growth of Logical Thinking from Childhood to Adolescence: an Essay on the Construction of Formal Operational Structures, translated by Anne Parson and S. Milgram. New York: Basic Books.

Kagan, J. and Robert Coles, eds. 1972. Twelve to Sixteen, Early Adolescence. New York: W.W. Norton and Co., Inc.

Kohlberg, Lawrence and Rochelle Mayer. 1972. Development as the Aim of Education. "Harvard Educational Review" 42(4):449-496.

C. How many pupils could these materials be expected to reach?

The middle school target population contains about a million pupils annually at each of the three grade levels, for a total target population of three million. It would be expected that this curriculum initially would reach no less than ten percent of this audience or 300,000 pupils annually, and could reach 50% or more of the target population with suitable implementation.

D. Are there any satisfactory alternative instructional materials in this area?

There are no materials based exclusively on hands-on, student-directed, individualized, self-contained, interdisciplinary activities. Most programs are oriented around a textbook or a series of texts, such as those for the Intermediate Science Curriculum Study ~~(ISCS); Introductory Physical~~ Science (IPS); Interaction series as published by Rand McNally, and the Concepts in Science Series published by Harcourt Brace. These and other series are based primarily on a text presentation of science in a structured scheme. While these alternatives may be satisfactory for textbook oriented program, the Human Sciences charge was for the production of a nontext program to which no viable alternative exists.

E. Additional questions or evidence important in answering this question.

The critical issue in curriculum development is to create innovative programs that are at the cutting edge of both content and pedagogy. Programs should be developed that the commercial sector has neither funds to pursue nor inclination to develop. In short, curriculum activities should bring forth materials not previously extant, that can stand not only on their own two feet in the classroom but also serve as models on which others can build and to which others can contribute.

Question 2: Is there a market for these instructional materials?

A. What other products are available to meet the need?

Practically every commercial publisher has a textbook program for the middle school population. Among the better known are the sequences published by Harcourt Brace, Lippincott, Rand McNally, and Prentice Hall. In addition, text programs such as IPS, ISCS and others sponsored by the National Science Foundation, have been commercially released.

The commercially sponsored and published materials are essentially paraphrases of high school materials, written in simpler vocabulary for students of the middle school level. The federally sponsored programs emphasizing laboratory work and process are a marked improvement over the written-down textbooks, but they too are text-oriented.

The Human Sciences Program is the only program under development for this target population that is a multimedia, interdisciplinary, hands-on, activity oriented, student-centered, individualized program. Its design is such as to eliminate the textbook and provide students with a wide variety of materials from which to pick and choose in the module areas of content and process. The program is designed with the student in mind and to capitalize on student involvement through a variety of experiences that appeal not only to interest but to ability levels. In addition, it should be noted that a strong emphasis is placed on the orientation of science within the societal framework, a position originally mandated to the National Science Foundation curriculum developers, but that now questioned.

B. Is there room for this product in the curriculum?

There is an already existing science slot in the middle school curriculum. The Human Sciences Program is identified as a program in science. Its social components, however, allow it to interdigitate with social science programs also available at this level.

C. How effective is the project's dissemination plan?

The project began with 21 classes in seven test schools throughtout the United States, primarily to provide feedback for materials revision. Subsequently, an implementation program was funded by the National Science Foundation consisting of four major centers: One each in Queens, New York, Baton Rouge, Louisiana; San Antonio, Texas; and Bellingham, Washington. Each one of these centers serves to train interested teachers and each of the teachers trained in these centers in turn serves as a resource person to train still more.

The aim is to make dissemination self sufficient in that not only will each segment of the program have a fully detailed teacher's guide, but there will be a teacher's guide that covers the entire philosophy, rationale and pedagogical implications of the program. These coupled with in-service training on the part of interested school systems will serve to disseminate materials in classrooms. In addition, thousands of copies of BSCS Special Publication No. 7, our Human Sciences document mentioned in Question 1, the BSCS Newsletter, and answering individual teacher or school system questions serve to disseminate materials still further. Certainly NSF implementation is not a requisite for the project's dissemination plan. However, there is no doubt that NSF funding of dissemination programs increases not only the rapidity of dissemination but its effectiveness as well by providing a critical mass of trained teachers to keep the program going. In short, NSF implementation is not essential but, if available, would be sought.

D. What has been the free market response to the need that these instructional materials are assigned to fill?

Publishers have been uniformly enthusiastic concerning the philosophy, rationale and design of the program. However, they readily admit that their organizations would not be able to fund the development of such programs. Because it is a non-text program and the publishing industry is strongly oriented to the production of textbooks, certain publishers have felt unable to handle the various components the program requires. However, we are currently waiting National Science Foundation approval to enter contract negotiations with either Hubbard Scientific which produces non-text materials such as the Me Now and Me and My Environment programs for the educable mentally handicapped, or with Sargent-Welch, one of whose components is Intercollegiate Press. Both of these firms are committed to the philosophy and background of the program and are competitively bidding for its publication.

E. What is the likelihood that the product would be used if available?

The interest in the program has been exceptionally high. We receive more than a hundred letters a month from interested teachers and school administrators concerning it. We have completely exhausted our stocks of Special Publication No. 7 and the Human Sciences publication. The demand for experimental materials has been so heavy that we have made arrangements to produce additional instructional modules at cost, which could be sold to interested school systems for classroom use. As of now, over a hundred of these modules have been sold as well as several thousand special teacher's guide packages, which provide a limited amount of module material as well as instructions on its use.

Attendance at national meetings and conventions in which the Human Sciences Program has been outlined has elicited a tremendous amount of response. We have numerous requests regarding when the program will be commercially available, for it fits a need not now met by any current program. We have no doubts that a target population exists ready, willing and eager to adopt the program as soon as it appears.

F. Additional questions or evidence.

The needs assessment indicated demand for the type of program developed, and even in its experimental stages the program has been remarkably well received as an innovation of consequence. Classroom feedback notes that students who had previously been disciplinary or truant problems have met success with this type of program, and have had their attitudes changed regarding schooling at this level. This is a most difficult time for students and teachers as students are in the process of changing from children to adolescents. A program that takes cognizance of this developmental change meets the needs of the target population largely neglected. There is no doubt in our minds that a market exists for these instructional materials.

Question 3: Do these instructional materials possess a clear purpose and rationale?

A. What are the stated assumptions, values and goals behind these instructional materials?

The materials are based primarily on a Piagetian developmental model wherein one assumes a variety of cognitive operations applicable to specific age groups. It is based on the assumption that direct experience is a more valid learning device than indirect communication. Further, we assume that students can learn individually with a minimum of teacher direction and we also assume a variability in student population that must be appealed to by a variety of activities. One assumption is that cognitive skills such as problem solving and critical thinking can be learned as can other elements of the curriculum. And, finally we assume that the skills can be taught as a logical process.

The materials do not foster a given value system, but rather ask the students to look at value conflicts and resolve them in view of individual analysis of data based on background and experience. Values inherent in the curriculum are critical thinking, autonomous learning, assumption of responsibility, cooperative efforts in classroom endeavors, shared managerial responsibilities between student and teacher for the classroom environment, decision making, evaluation of data, dealing with problems, self evaluation of individual performance, scientific approaches to problem solving and value judgments based on evidence. The goals are elucidated in Section 6 entitled "The Recommendations" of BSCS Special Publication No. 7, Life Sciences in the Middle Schools.

B. What assumptions, values, and goals may be inferred directly from the instructional materials themselves?

The materials are designed to elicit those goals and behaviors under A. above. Inference, like beauty may be in the eye of the beholder. One person looking at a sunset may be impressed by its beauty. Another looking at the same sunset may only wish to complete an outdoor task because it is getting dark. The materials themselves pose no inferences not in keeping with the stated assumptions, values and goals of the program.

C. Is it reasonable to expect that instructional materials based on these assumptions will fill the need documented in question 1?

The program was carefully structured in response to the initial needs assessment and every important need has been dealt with in the materials so far prepared.

Alternative assumptions, values and goals can always be generated. For example, instead of using a Piagetian model that takes cognizance of student's development stages, a Skinnerian model of behavioral modification could have been selected, or an Ausabelian model of advanced organizers. It was felt that no other educational theory so well matched the needs as elucidated in the initial assessment as the Piagetian model and the assumptions, values and goals that derived from it.

D. Are the instructional materials themselves clear and understandable? Do they form a cohesive package? Is the sequence of presentation clear?

Extensive field testing over the past three years has indicated that the materials are comprehensible to students. The materials are not designed to form one cohesive package, but, because of the alternatives presented, there are sequences to which the teacher is privy that form a learning continuum. A certain amount of planned redundancy and relationship exists between the modules at the various grade levels, and certain modules and activities sequences are desirable to be performed before others. These are clearly delineated in the teacher's manual.

E. What is the rationale for the selection of individual curriculum modules?

The modules have been designed around the concerns and interests of students as elucidated by the extensive interview program. They are designed to focus upon the interface of the natural and social science disciplines. They are selected because they offer direct experiences of a concrete nature and the possibility of the direct observation of phenomena. Formal learning sequences are delayed until later in the program to take advantage of the students reaching the appropriate developmental stage. As the student progresses through the modular sequence, additional formal questions are evidenced.

The needs assessment clearly delineated the interests and concerns of students. The Piagetian model forms a theoretical base into which these interests and concerns can be intercalated. The purposes have been clearly delineated and a rationale for their achievement developed. The assumptions, values and goals have been published, widely distributed and commented upon, and form an agreed upon base for curriculum development.

Question 4: Is the content of these instructional materials scientifically correct?

A. To what degree are the instructional materials scientifically accurate?

Distinguished biologists such as Russell Stevens, Bruce Wallace, Val Woodward and others were involved in the initial conferences to delineate a content framework. Materials were prepared by skilled teams of writers including both scientists and educators. The materials, in turn, have been reviewed by additional content specialists to insure accuracy.

B. To what degree are the instructional materials scientifically current?

As noted in A. above, consistent involvement of outstanding scientists and educators in every stage of the developmental sequence has insured the most modern of content as well as its accuracy.

C. Is the content of these instructional materials aimed towards training future scientists or toward a scientifically literate population?

Out of a typical Middle School population, less than 50% will be going on to college and of that number less than 5% will pursue careers in science. Therefore, the major aim of the program has been directed toward a scientifically literate population. This does not mean, however, that the science directed student will not profit from development of cognitive skills, logic, critical thinking, autonomous learning, responsibility, decision-making and the scientific approaches to problem solving that are intercalated in these materials.

D. What portion of the discipline and approach to the discipline is represented by these instructional materials?

At the Middle School level the curriculum slot is labeled science. The major Human Sciences emphasis among the sciences is on biology, as studies indicate it is the discipline of greatest immediate interest to students of this age. However, engineers, earth scientists, physicists, chemists and others have been involved in the development of cross disciplinary activities and social scientists have been employed to aid in the cooperative development of the interface focus between science and social science so characteristic of this curriculum.

E. Additional questions or evidence.

The materials of levels 1 and 2 have gone through an extensive testing program, and are in the process of being rewritten on the basis of feedback obtained from their use. Level 3 materials are being tried out in schools this year. When all three levels have been evaluated in the classroom there will be a complete review of the program to insure the maximum effectiveness of sequencing of materials and the interdigitating of normally discrete science disciplines together with societal concerns.

Question 5: Is the content of these instructional materials educationally sound?

A. Do you anticipate any adverse reactions to these instructional materials? Are there especially favorable reactions which may also be anticipated?

No one can guarantee a curriculum to be free from potential adverse reactions. There is almost no textbook that has been free of criticism from one splinter group or another. In the biological sciences, because they deal directly with humans and their behavior, we could expect Christian Scientists to be exercised about the germ theory of disease, Catholics concerned over population control, anti-vivisectionists against the classroom use and presence of animals, negativism from anti-evolutionists, and protests from those who feel that reproduction is not a fit topic for school children.

We have taken every reasonable precaution to avoid offending any particular group and to present a balanced and reasonable account of the sciences in their social setting. We cannot, however, in good conscience, bowdlerize the discipline to remove every potentially contentious item. To do so would leave the curriculum a bland pudding of morphology, systematics and chemical formulae to which no one would object, simply because the curriculum has no interest for them. We have attempted honestly and straightforwardly to cover relevant scientific information without unduly upsetting the flat earth society, astrologers, believers in the occult, food faddists and others who tend to take issue with scientific information at variance with their own belief system.

The implementation plan for the material is such that parents, pupils, teachers and administrators are involved in full and frank discussions of materials prior to their introduction into the classroom. In areas where a sensitivity exists, such as human reproduction, this sensitivity is called to the attention of administrators and teachers and discussed with parents. Fortunately, the program is so structured that specific activities can be removed from a given topic area within a module without completely vitiating the thrust of the module of the specific topic area. Activities are supplied in excess of what will normally be done in order to make valid choice possible. An especially favorable

attribute of the program is the ability to tailor it to a set of community mores or for a selection of activities within a module to be made available to the students, as the student has no textbook but selects only from a panoply of activities. These opportunities, unlike the situation with the standard textbook, offer a flexible content and order of materials so as to make certain materials available to students who are ready for them, and to deny access to such materials to students who are not.

On the basis of classroom trials, we have had exceptionally favorable reactions to the materials. Especially strong points commented upon have been the flexibility of the materials, their applicability, their high degree of interest to the student, the developmental approach, the individualization, the proceed-at-your-own-pace timing, the self-evaluation and the noncompetitive, non-threatening nature of the materials to each individual student.

B. Does the content approach present any special difficulties for the students at the age and development level targeted?

One of the strong features of the program is that the content and approach have already taken note of the cognitive, affective and maturational stages of the students of the age and developmental level targeted. The variety of materials presented offers students opportunity to exercise skills that they have already developed, and to develop skills they do not yet possess. This variety appeals to students of varying ability, those who are passing formal thinking stages, and those interested in a wide variety of science-social problems. The program has been tailored with a variety of learning styles and types, and in the absence of rigid proscribed sequences, obviates difficulties met by materials that "have" to be accomplished in sequence.

C. Are there any students for whom this content/approach should not be used?

We have had no experiences with student populations that have not found the program effective. The choice of activities and their sequencing appeal to most students. Students who have been brought up on a rote memory, rhetoric of conclusions approach to science and education in general, may be initially disturbed by being on their own with minimal teacher guidance for this program, but soon come to participate in the overall classroom activity in a constructive fashion.

D. What are the instructional materials' strategies for dealing with value-laden areas?

In addition to the publications that provide an insight and overview of the entire program, each module has a Teacher's Guide that includes all student activities and instructions to the teacher relative to each. The activities within a module are divided into problem areas. The number of students who should be working with a given activity is listed.

The focus of the activity and its objectives are clearly delineated. The teacher is provided with additional opportunities for students who wish to pursue the given activity further, and teaching considerations that warn the teacher of potentially sensitive areas and how to deal with them are elucidated. Problems are selected to encourage students and questions the teacher could use for interaction with students are presented. Teachers are also provided with information that facilitates student self-evaluation, and with data as to how to elicit student choice of problems. The teacher's guides which accompany the experimental materials are undergoing revision based on teacher feedback and should have any current inadequacies rectified.

E. Additional questions or evidence relative to content.

The content implied by the term science is vast, and when to this is added the social implications of scientific material, curriculum developers are faced with critical decision making regarding selection of materials to be covered. No attempt has been made to cover all the fields of science and social science, but a judicious sampling of the sciences and their social relevance has been made. In terms of the developmental stages of the students, content has been selected that will most likely be effective for students who are largely in the concrete stage of cognition.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

A. What are the anticipated impacts of these instructional materials on all consumers?

(1) Students - To learn how to learn, to develop multifactor approaches in seeking alternative explanations to problems. To make cross cultural comparisons of critical biosocial issues. To analyze controversial issues for their empirical and ethical elements and deal with them in socially constructive ways. To draw upon a wide variety of resources as elements of creative thinking. To develop an understanding of man as a social and biological being. To develop confidence that phenomena are explicable. To practice in real problem contexts such specific inquiry skills as observation, interviewing, information display, decision making, analysis and question asking. To develop interest in and curiosity about the future. To gain experience in the potentialities and limitations of the methods of scientific and social investigation. To develop individuality and to encourage reflection on the democratic core values which lend stability to American society.

(2) Teachers - To make the teacher a true intellectual resource. To free the teacher from routine managerial tasks. To give the teacher more time to spend individually with students. To create a student centered evaluation system to free the teacher from grading constraints. To allow the teacher to recognize his or her potential as an educator.

(3) Administrators - To meet the educational needs of the community being serviced. To provide a depth and breadth of educational experience to maximize the effectiveness of the teaching situation. To accommodate to a wide variety of student interests and abilities. To involve parents and community leaders in curriculum decisions.

B. Which of the intended effects would be realized as a result of using these materials?

While it would be simple to say that all of the factors in A. above should be realized, local constraints, personalities, training, background, school organization and community mores will not allow all of the intended effects to be realized. However, even if only a fraction of those anticipated impacts were to be realized, the program would have been successful. In trial situations, where none of the anticipated impacts have met with negative response, the demands of time, class size, and other factors not related to the value of the materials have militated against the accomplishment of all.

C. What unintended effects might you anticipate as a result of using these materials?

In the hands of the careless, slipshod, or unprepared teacher, these materials, as any classroom materials, could be perverted to unanticipated ends. A teacher who did not see the program as an opportunity to interact with children, but rather one which required no teacher participation, would cause a great deal of the curriculum design to be vitiated. The converse is also true. A teacher who insisted on being the center of all classroom activities and not allowing the students to achieve their own potential would seriously affect the open autonomous learning pattern built into the program.

D. Is the content and approach of these materials fair?

Every effort has been made to avoid sexual, racial, ethnic, and religious bias or stereotyping The illustration program shows boys and girls in a wide variety of activities but does not reinforce stereotyped patterns. The materials emphasize minorities and stress ethnic contributions to science and society. In its social and science orientation, the program is devoid of religious bias or religious emphasis.

E. What are the important process features?

The major process features are listed in A. above. In terms of science specific process features, the program includes observing, questioning, describing, speculating, interpreting, valuing, choosing, verifying, comparing and experimenting.

F. In general terms, it can be stated that no curriculum developer knowingly proposes or anticipates outcomes for instructional materials that would be undesirable. Therefore, desirability becomes a relative matter of who desires and to what purposes. Honesty may be desirable in the eyes of some, but not in the eyes of others. This question assumes that there is a given set of desirable characteristics on which all are in agreement. If this were true it would be easy for the National Science Foundation in its curriculum activities to demand these as <u>the</u> desirable outcomes of education.

Question 7: Do these instructional materials present implementation problems for the schools?

A. Is special training needed by teachers to use these instructional materials effectively?

The content is not beyond the ken of the average middle school science teacher. The methodology involved, however, while it may be familiar to most, has not been that commonly employed in their own classes. The teacher's materials provided are adequate for those who will read and follow the program as outlined.

Any program is helped by special training. It is possible to be a self taught painter or singer, but professional lessons increase the proficiency of the learner. Similarly, teachers can be self-taught or expedited towards a given end by an implementation program. While training is not essential, it would be markedly helpful.

B. Do these materials pose any special problems for existing organizational structure within the schools?

The instructional materials are designed to fill the science slot currently existing in the Middle School curriculum. They do not require special laboratories or esoteric equipment and should fit easily within current practice and organizational structure. They require no redefinition of the curriculum, but may encourage closer cooperation between the science and social science teachers in a given institution.

C. Are the costs of these materials realistic?

The modules have been carefully costed out and are price competitive with other multimedia activity oriented programs.

D. Do the new instructional materials require any special learning resources?

They require nothing not now normally found in schools. The modules are self contained with all necessary printed matter, forms and media.

E. Will the new instructional materials require school districts to establish optional classes?

The materials, by offering a wide variety of activities within each module, are specifically designed not to require optional classes. Activities are at varied levels of difficulty, at varying interest levels and, if values contrary to the values of the community are anticipated by use of any given activity, it can easily be removed from the sequence. The flexibility of the materials appeals to interests of students with a wide range of abilities and allows a class of mixed achievement to work together as a unit.

F. Additional questions and evidence.

The initial needs assessment dictated early that the curriculum be non-threatening, fit the existing school slot, and require no special training or change in organizational structure in the schools. They were designed to be cost competitive, use common materials and cover the range of student abilities and interests in any given class.

Question 8: Are the costs for implementing these instructional materials reasonable?

A. What are the expected total dollar costs for implementing these instructional materials?

In experimental format, a complete module containing all necessary materials for learners, teachers, staff, training personnel, installation, etc. has been around \$200.00. There are five modules in each of the first two years, and four modules in the third. Discussions with commercial publishers indicate they feel that the cost per module will be competitive. Efficiencies of mass production should bring module costs under \$200.00. It should be noted that one \$200.00 module provides approximately 8 weeks of instruction for up to 200 students per day, which makes the cost per pupil per year negligible.

B. What are the costs of continuing use of the instructional materials?

There are no support service costs. Depending on how many students use the materials, the expendable items are replaceable at a cost of \$20 to \$30 per year per module.

C. What other ways might the school district spend money to meet the same need?

As no other comparable program exists, there is no way to purchase a similar program. The other alternative would be to purchase textbook oriented programs of instruction for the middle school.

D. What are the expected costs of comparable instructional materials?

There are no comparable instructional materials. Costs of other federally supported projects that reach this target population, such as SCIS and ISCS are in the same price range as the Human Sciences Program.

E. What non-fiscal costs might be involved?

There should be no nonfiscal cost, but rather a non-fiscal credit for those adopting the program. The only time a nonfiscal cost could be accrued would be, in this program as in any, if the materials were forced on teachers who had not subscribed to the goals of the program. The dictation of a new teaching style not acceptable to the teacher would be deleterious for both teacher and student.

F. Additional questions and evidence.

The Human Sciences Program is a unique one where structure and pedagogy are completely innovative. The costs for all innovative programs are similar. Human Sciences is no more expensive than other new programs.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

A. Has there been adequate opportunity for interested parties to provide input into the development?

Yes, the model adopted for curriculum implementation and instructional improvement involves inputs from private enterprise, the scientific and educational communities and governmental agencies. It operates with a sequence of organization from a coordinating group, which is a national level committee representative of government, industry, professional scientists, biologists, science educators, science curriculum coordinators and middle school teachers. The coordinating group interacts with regional centers staffed by several master teachers equipped with the resources prescribed by the program. These, in turn, work with teachers from the community centers who adjust the curriculum to the demands of regional and local settings. This activity includes working with parents to engage their interest and support for the new course. Feedback travels from the community centers back

to the regional centers and the coordinating group and to the schools and ultimately the individual students. Literally hundreds of people have been involved in the structuring, development and implementation of this program.

B. Are there adequate internal monitoring procedures for the project?

Yes. Constant evaluation of each module and each activity area within the module provides continuous monitoring of the materials and the reactions to them. This monitoring feeds back into the revision cycle and is apparent in rewritten material.

C. Are there adequate external evaluation procedures for the project?

An external advisory committee oversees the entire project and provides policy guidance under the chairmanship of Dr. Paul DeHart Hurd. In addition, content reviewers check for content accuracy and modernity while other reviewers check for pedagogical continuity.

D. Does the project seem to be top heavy administratively?

The project administration is tailored to the tasks to be accomplished. Spartan administration and minimal bureaucratic control are two key words in the administrative design. Administration is considered adequate and flexible.

E. Is the project staff providing adequate information to NSF?

Yes. In the term of quarterly reports, periodic correspondence, information on changing personnel and directions and consultations with the NSF staff, both in Washington, D. C. and Boulder, Colorado. NSF personnel have been invited to test schools and test centers and have visited both. There is a constant dialogue between the National Science Foundation and the project staff regarding project progress and changes.

F. Additional questions or evidence.

The track record for this program speaks for itself. An entirely new model has been created and materials produced for three years of classroom instruction with commensurate evaluation, testing, feedback and revision. The program is now at a stage where it can begin to be passed into the hands of the commercial sector and made available for teachers and students. The fact that it has attracted a great deal of attention in the academic communities and favorable reaction indicates a soundness of design. The fact that two commercial enterprises are anxious to publish the material indicates that it has a salability worthy of private investment. The management education plan had to be adequate to achieve these goals.

D. 12. c: HSP (panel 5): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The HSP staff conducted a needs assessment as early as 1966 with several additional conferences, checks, and feedback programs designed to seek direction from schools, students, and the public. This needs assessment is considered by the panel an important feature of the project.

Some of the needs to which HSP responds include:

1) learning materials specifically for the middle and junior high schools;

2) materials which emphasize societal needs,

3) science for the middle school years which emphasize the interrelationship of science and society, science discovery and application, science and other academic disciplines,

4) a curriculum with the student and his/her immediate environment as central to the activities,

5) a program that considers issues, problems and values as well as basic content,

6) materials appropriate for all students in grades 6, 7 and 8,

7) materials that allow choice, sequencing by the student, and individual approaches.

These needs are generally identified, discussed, and advocated by current educational leaders, researchers, and philosophers.

Materials are generally appropriate for the diversity of students' maturity during the three-year middle or junior high school years. This program could serve a potential three million students annually. The developers report that the program will initially reach "no less than ten percent" of this population with an anticipated goal of fifty percent if national implementation programs are conceived and supported.

The HSP represents a unique program with the previously listed characteristics. In addition, HSP can be described as a hands-on, student centered individualized, and interdisciplinary learning experience. The non-textbook nature of the program makes it unique. The panel endorses the developer's claim that no viable alternative materials with these characteristics exist.

Question 2: Is there a market for these instructional materials?

At present, many types of middle school/junior high school science

programs revolve around the use of a textbook. Thus, the Human Sciences Project materials add a significant dimension to available science curriculum.

Because of the modularized approach, this curriculum, or fractions thereof, can be used within present science courses. The Human Sciences Project could be offered as an alternative to or replacement of the present middle school science program.

Since the curriculum project treats topics not traditionally presented in the targeted grade levels, some in-service teacher education must be included in any implementation program. The training should include discussions of handling potentially sensitive issues (e.g., divorce) as well as reviews of basic biological and social sciences.

The panel is not aware of any similar materials which have been produced by commercial publishers for the same audience. Since we believe that this project is a good alternative to present science curricula, we hope that commercial publishers eventually will consider developing materials with characteristics listed in the answers to question 1. However, we do not expect such action until the basic developmental and feasibility studies of the Human Sciences Project are completed.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The instructional materials possess a clear purpose and rationale. The panel agrees with the stated assumptions that, by using the materials, cognitive skills such as problem solving and critical thinking can be learned as can other elements of the curriculum.

The panel agrees with the project staff that "values inherent in the curriculum are critical thinking, autonomous learning, assumption of responsibility, cooperative efforts in classroom endeavors, shared managerial responsibilities between student and teacher for the classroom environment, decision making, evaluation of data, dealing with problems, self evaluation of individual performance, scientific approaches to problem solving, and value judgments based on evidence."

The instructional materials allow for the fulfillment of the assumptions and the goals since, by design, only those units acceptable to the parents, teachers, administrators and community members would be used.

The general groupings into which the curriculum is divided are well conceived. In addition it provides for choice on the part of both student and teacher to design a cohesive package to fit the educational needs of the community. The field testing procedures will provide feedback which will allow the staff to revise, add and/or delete materials. The final product should be a curriculum which is clear and understandable to most students in the target group.

The modules were designed 1) to meet the concerns and interests of the students and 2) to focus upon the interface of the natural and social sciences. The educational effectiveness of the modules is plausible since the materials offer the use of direct experiences as well as phenomena through observation as the learning mode.

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>

The materials are scientifically accurate. The thoroughness with which internal monitoring is performed assures accuracy and currency.

The panel feels that many areas are superficially covered rather than in-depth. As a result the program addresses itself toward developing a scientifically literate society. The materials, although human biology oriented, have had input from other natural sciences as well as the social sciences.

In telecommunications with review panelists, the project staff indicated that some of the materials which do not fulfill the stated objectives are being removed or revised.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

The fact that the HSP program addresses itself to current problems suggests that portions of the curriculum could possibly lead to controversy and difference of opinion. The availability of modules on these issues, however, is an attractive feature of the program.

The materials are educationally sound. They are individualized in a manner which gives students the freedom to respond, the freedom to choose, and the freedom to proceed at a chosen rate. HSP is not a course or a course sequence in the traditional sense. Its modular nature provides opportunity for schools, teachers, students and communities to structure the kind of program that is meaningful to them while providing a resource of suggestions which are concerned with meaningful and significant topics in today's society.

Compared to other available programs, the HSP program is less dependent upon student reading ability, interest of all students, and general ability, motivation and level of maturity. The approach to HSP content, if handled in the manner recommended by the developers, insures that students at different levels can be accommodated. The materials and the approach, largely because of the nonprescriptive characteristics, appear to be equally appropriate for all students.

The HSP program includes a large number of supplementary instructional aids to help schools, communities, and teachers use the materials effectively. In addition, there is an impressive Teacher's Guide for

each module. Teachers are provided information to assist with student self-evaluation, with facilitation of further student interaction, and with assurance of appropriate handling of issues with individual students.

Although there has been no attempt to include all science topics, the HSP content is educationally sound in the scope, content and methods utilized for considering it. The panel is convinced that the HSP materials completed to date and the results of the field tests to date indicate that the materials are indeed educationally sound.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The anticipated impacts outlined would provide expanded opportunities to middle school students in science education with the focal point being human science. The panel expects students to find the program interesting and stimulating.

Teachers may need to develop additional skills to handle the subject material effectively. In particular, teachers would need to be prepared to handle reactions of students to the social issues that are treated in certain modules.

School administrators and boards of education may be placed in a position of defending the adoption of the materials because of the explicit nature of certain sections on development and reproduction. The target population, because of its diverse level of mental and physical development, may need to be selectively screened to provide alternate activities. This same problem will be experienced with certain non-sensitive materials because some of the activities seem to be simplistic and would not challenge the more mature students in the middle school age group. However, because of the modular approach to the learning activities, selective assignment based on the needs, abilities, maturity and interest of the user can be easily arranged.

The panel recognizes the need for educational activity with socially sensitive material. Potential users of HSP should be cautioned that there is some of this type of instructional activity included. The panel suggests that there may be parental reaction to the introduction of a few module topics presented for review.

There is no discernible sexual, racial or ethnic bias in the material provided the committee. There may be some selective use of modules depending on the sex of the student. However, this is not because of sexual bias but rather as a result of the varied maturity levels of students in the targeted age group.

Question 7: Do these instructional materials present implementation problems for the schools?

To use these instructional materials effectively teachers need skills in the use of individualized instruction procedures, self-paced learning and

the inquiry approach to science. Depending on their background and experience, teachers may need special training in order to guide students of various levels of maturity through those activities which deal with human growth and behavior.

If a school official does not recognize the validity of individualization and self-pacing, the traditional structure can be adapted to this program. The freedom and responsibility to be assumed by the students can be introduced gradually with a minimum of schedule changes and classroom reorganization. It should be recognized that teachers who are to direct more than twenty-five students at a time in this type of program will need some type of classroom assistance (school aides, student monitors, or peer facilitators). The panel would like to emphasize the importance of the teacher commitment to this learning approach.

The modules are multimediated and cost-competitive. Most of the resources needed are normal budget items or available within the school.

If a school district chooses to adopt the complete set of modules, the administration may wish to conduct the parent orientation program recommended by the project directors. It should be made clear to the parent that there is provision for students to choose topics within a given areas as well as to choose areas in which to work. Procedures should be established which provide parents, if they so desire, with the opportunity to participate in their child's choices.

Question 8: Are the costs for implementing these instructional materials reasonable?

The materials costs for the program are no greater and, possibly, less than the costs of other junior high school science programs. Similarly, refill costs should not exceed current costs for middle school/junior high school science course materials.

The present form of the HSP curriculum does introduce subjects which have potential psychological and/or social impacts. For example, modules on the topics of divorce, death and reproduction are being tested. The panel believes that these impacts may be minimized in three ways;

1) Because the materials are modular, any topics can be eliminated from the program.

2) The project staff and trial centers are undertaking a careful study of all materials. This study includes reaction of parents as well as students. The panel believes these tests will result in an identification and revision of potentially sensitive areas.

3) Orientation programs can help teachers predict and cope with individual student reactions.

The panel believes that a school need not eliminate a topic from the curriculum solely because it is socially or psychologically sensitive. Programs which will better prepare teachers to teach such topics should be funded.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

Answers to questions addressed to the directors of the project disclosed a well organized plan of consultation with educational administrators, teachers, parents, and scientific writers. Monitoring, feedback, and materials modification take place and are observed directly by administrators of the project. Evaluation procedures are currently underway. The administrators appear to be well informed about all phases of the project which indicates that there is neither a cumbersome excess nor a shortage of administrative direction. The management/organizational flow chart includes job descriptions. NSF has been adequately informed through periodic reports, correspondence and open communication.

On the face of the materials seen by the panel, management/organization plans are demonstrated to be excellent and well-executed.

D. 12. d: HSP (panel 5): Individual Panelists' Responses to 10th Review

Question: What are your general impressions of the curriculum?

Panelist: Dr. Daniel F. Burton

Some input should be made to certification agencies, to appropriate departments of teacher training institutions, and to teacher organizations that develop standards for certification for middle school teachers. Middle school teachers should be prepared broadly enough in transdisciplinary programs if this kind of instructional material is to be adopted.

Middle school age group youngsters will become less numerous each year, therefore fewer openings will exist for new teachers. Attrition is not apt to increase teacher turnover as rapidly as growth did. Therefore, an in-service program will be needed even if future middle school teacher certifications are based on broad curricula. Implementation costs must include such in-service training if the program is to be adopted broadly.

Panelist: Mr. Wayne E. Carlson

As a parent I am enthused by a curriculum of inquiry being developed for 11-13 year olds. In reviewing the intended goals of the project such as free choice of activities, opportunity for self direction, interaction with a lot of people, developing a realistic sense of self confidence and competence, developing a sense of pride and responsibility and getting pleasure and satisfaction out of learning; as a parent one cannot help but be enthused. Learning how to cope with change is one of the most important life skills today. The organization of the four general divisions - introduction to change, change in non-human organisms, change in humans, and change in non-living things - is very relevant in guiding youth through an appreciation of change and its role in their life and the world in general.

As a parent, there are some new aspects of the program which I particularly like--inclusion of the social sciences; however I naturally have a concern that parents be advised of these new programs so adequate understanding and support can insure continuance of this new approach. This will mean the need for some adult education on some of these topics like divorce and death. I can envision some teachers not being prepared to deal with these adequately, especially if either of these are occurring in the child's home at the time these modules are being introduced. This is where parental support can be so valuable. It is therefore essential to keep parents informed.

The materials are very well written and apparently the project of development, implementation and evaluation are very well organized and managed. An excellent product is emerging. Continued funding including funds for evaluation is encouraged.

Panelist: Sister Shirley Corbliss

The Human Science Program responds to the very diverse needs of the target group, by the individualized, self-paced, inquiry approach it takes. While I see the necessity of providing teachers with opportunities to develop the skills to adapt to the type of educational approach, I believe that the benefits that can be derived from this type of program by students throughout the country are well worth the cost, which in most districts will be minimal.

It cannot be stressed enough that teacher commitment is important to enable students to derive the greatest benefits from this type of program. Teacher enthusiasm is contagious and teacher education institutions can provide the opportunity for the kind of exchange that is most beneficial for teachers adopting a new type of curriculum. The ability to develop a relationship with the local community which will enable the teacher to help the student choose wisely and well from the multiple topics treated in this curriculum is enhanced by opportunities to find out how other teachers in other communities did it.

This type of program can be a very important component of educational improvement in urban areas and serious consideration should be given to the funding of implementation programs, especially for urban school populations.

Panelist: Dr. Richard A. Dodge

The Human Science Program represents apparently a unique entry into the junior high and middle school population to provide an integrated science experience utilizing the human organism as the principle instructional focus. It seems quite appropriate to use this focus since learners in the 12-14 year age bracket tend to be self-centered and respond to introspective study. Because there apparently is little available material in a formalized development curriculum, it seems the focal efforts are praiseworthy. While I fully agree the values structure of the project covers what might be categorized by some as socially sensitive material, I believe the information must be presented to this age group from a clear scientific point of view. However, the wide diversity of maturity among representatives of this age group does lead to certain problems concerning value-laden and sex education efforts. Some of the provided examination materials could not be accepted from the scientific information standpoint by immature learners in this group. In particular, caution toward the presentation of explicit material related to sexual development and operation must be exercised; not that the learner should not be taught this material, indeed probably needs exposure for his own social development, but because certain parents may object to the educational system responding to potentially sensitive subjects.

While the above reactions are valid for certain produced modules, I hasten to point out alternative activities and great flexibility for instructional content exists in the developed programs and, thus, teachers can selectively choose activity materials for educating the youth population targeted. I

strongly feel, however, that teachers undertaking the Human Science Program curriculum will need intensive workshop experience to successfully present the material and deal with student reactions to material as well as parent and public input. Very careful evaluation of the school community and instructional environment should be undertaken before introduction of certain modules. I should not want to dwell too long on this aspect of the program, however, since this represents only a portion of the excellent material developed and, because of the modular approach to the instructional plan, alternative materials are available so that a complete course can be offered to many diverse social attitudes.

I would make a strong plea here, however, to provide for implementation training sessions for teachers preparing to offer these curricular materials. To do less would limit the effectiveness of the program and could, in fact, result in parental reaction which could cloud the overall excellence of materials developed.

Panelist: Dr. Roger W. Hanson

I approve of the program and my impressions are generally good. Any reservations which I might have had were personally answered by the project director and his staff. They were aware of some constraints which may affect the acceptance of certain modules.

Unfortunately this program may be somewhat limited because of the lack of middle school development--a system which appears best able to accommodate it.

Panelist: Dr. Fred D. Johnson

The Human Science Program is very impressive. Based on my experiences in public schools, I am convinced that the middle school curriculum is the area in the greatest need of improvement. The Human Sciences' program is one of the most promising efforts that I have seen. The other major efforts in this area have emphasized physical science concepts.

The Human Sciences' approach is logical and consistent with the philosophy of the middle school. The curriculum is built around leading psychological research for children of middle school age. This curriculum provides students an opportunity to engage in biological and sociological activities that are relevant for students at that age.

I would recommend to the staff that continued creative and critical thought be given to student evaluation and teacher preparation models. Research and revision must be continued in these areas if the materials are to be implemented on a widespread basis.

Panelist: Mr. Andrew H. Miller

The Human Science Program is an excellent modular middle school program that has many flexible possibilities. The program can easily be adjusted

to a particular region of the country without damage to the HSP as a whole. Controversial issues in the program such as divorce and death can be omitted if parental pressure is strong enough. The withdrawal of these programs, although depriving students of needed discussion, does not damage the HSP in any way.

The HSP staff is definitely an experienced group of educators. This is demonstrated by the concise evaluation of the program.

No apparent aspect of the program was overlooked in the test schools and no major implementation problems occurred. The program could not have been operated by a more efficient group. One important item that exists in the test schools is the student's choice of the HSP or the regular science program. This option is important to retain in the early stages of implementation. Overall, the HSP possesses tremendous potential for the future of middle school science.

Panelist: Dr. Gerald A. Myers

The content accuracy of HSP, the organization of the projects, the evaluation processes planned, the capability and experiences of the directors, developing writers and tryout teachers leave little doubt in my mind that the project is successful to date and will have an impact on the middle school education of a positive nature.

Panelist: Dr. James M. Stevenson

The Human Sciences Program is an excellent example of a curriculum developed by professionals long active in the field. The information and its format of presentation were outstanding. The nature of the materials and the presentation of life problems likely to affect any individual can be invaluable. Most impressive to me as a psychiatrist is the utilization of the classroom for self and group examination of problems too often relegated to a psychiatrist's office. Discussing divorce in class brings focus to the responsibility one has in choosing marriage partners. This is only one outstanding example for this curriculum.

Several problems deserve studied contemplation. Firstly, the sophistication level of the teacher is extremely important. Teachers must be given the opportunity through seminars and group meetings to verbalize their own feelings and frustrations concerning certain subject material. No teacher should be allowed privy to the dissemination of this excellent, charged material unless he/she can do so unhampered by personal judgements.

Secondly, the maturity level of the age group is of concern. Middle school age-range children vary tremendously in their backgrounds. Some will find it laden with highly emotional and social issues with which they are dealing. Credence must be paid to the individual in the classroom and his high degree of maturity. The material is not acceptable to all children in this age range.

Thirdly, the nature of some of this information and its presentation will precipitate reaction in many communities. Reproductive material may be objectionable in some quarters. However, again, adequate preview opportunities for parents may help alleviate this problem.

Finally, I would like to comment on a matter I consider to be of a serious nature. I have conflicting feelings, but an overriding opinion, concerning the degree of freedom educational institutions have with our young people. For the past several decades there has been a rapid replacement of the parent as the principal teacher by the school system. Again, as a psychiatrist, this is frightening to me. I doubt the institutional setting, however well meaning, can adequately parent our children. I resent the license this setting takes in determining when my child is mature enough for certain kinds of information as I seriously question the efforts of individualized attention this requires. I sometimes feel my freedom is usurped. Community involvement in curriculum selection is a necessity; this ultimately provides more freedom for teachers and parents alike.

Panelist: Mr. J. Howard Straiton

It is refreshing to read material in which authors are directing attention to the fact that "middle school" aged youngsters are emerging adults. Many have not yet lost their spontaneous curiosity and adults must address themselves to the child's needs.

Forty years ago, educators were promoting the junior high school concept because of a recognized need for special emphasis on <u>exploration</u> and <u>transition</u>, school system personnel created "new" schools as "junior" <u>high schools</u>. The traditional patterns where child centered elementary school teachers turned their charges over to the subject centered secondary faculty members, in most cases, were not changed. New opportunities are being created in middle schools (the junior high is a middle school) but community tradition, existing learning material and teacher attitudes must also be changed. Unless one spends considerable time on the scene considering the barriers to accomplishing positive approaches to reach each individual student, change and anticipated learning will not take place. Many adults assume that eleven, twelve and thirteen year-olds have become of age and are ready to put elementary skills to use in systematic searching and processing of data. Many also assume that interest "naturally" exists and that these youngsters are ready to conceptualize and reflect on the complexities facing our society based on studies in the natural and social-behavioral sciences.

False assumptions will compound existing problems. Implementation of these materials must include the close look at each school's target population, teacher attitudes and logistical problems. Conditions that seem to require continuation of teacher/student ratios of <u>one</u> teacher to thirty-plus students and the broad mix of interests, abilities and maturation levels prevalent in many junior high school classrooms are most significant reasons for teacher concern in our junior high schools. ...Finding new approaches to learning and new material are also concerns.

The HSP program specifically addresses itself to the last two concerns.

Panelist: Dr. Robert E. Yager

HSP as it exists to date is impressive with respect to content, teaching styles, and format. The materials are designed to meet the needs of students at the middle or junior high level and for society as a whole during the late 1970's. It is the kind of model for which the Foundation has become known by providing national leadership.

The approach to values, content selection, teaching style, and curriculum format are all examples that illustrate where we are and where we are going with respect to science education today. The project has sought out, and apparently used, some of the best minds and most talented people.

There is some concern whether there has been a consistent sense of direction during the history of the project. This is indicated by the fact that there have been three project directors in a relatively brief span of time. The use and impact of the advisory committee upon the regular staff members is not always apparent. Perhaps diverse input and some trial and error are in actuality, a program strength. Certainly the product - the HSP - as available at this point in time would suggest such.

The program is significant and impressive enough that early dissemination and implementation needs should be established and appropriate strategies developed. If the Foundation is to provide leadership in developing and producing major new models for the science curriculum, such models should not be left for schools and teachers to find and use as a matter of chance.

Panelist: Dr. Dean A. Zollman

The Human Sciences Program represents a major and important departure from other middle school or junior high school programs. I applaud the efforts to modularize and individualize the curriculum. However, I am concerned that both the content and methodology will be foreign to many middle school teachers. These teachers may need orientation and education to help them treat social issues, to facilitate individualized learning and to present unfamiliar content. Without this training the teachers may attempt to fit HSP into the more familiar, traditional instructional system.

I wish that local school districts would take the responsibility for this type of in-service teacher education programs. In some cases, the schools will. However, in many situations funds will not be available. To help provide adequate preparation, funding agencies, particularly NSF, should be prepared to support teaching training programs.

The program, as with many others at this level, emphasizes one aspect of science at the expense of others. A school administrator is faced with the choice of adopting a program which is mostly physical science or one which is mostly biological science. Because of the modular approach, HSP has the potential to become broader in scope--including more physical science. Thus, a school official could adopt the program and choose a balance of the various sciences which fit his/her needs.

D. 13.a: EHN: NSF Descriptive Information

PROJECT TITLE: Exploring Human Nature (EHN)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Principal Investigators:

Irven DeVore
Professor of Anthropology
Harvard University

in association with:

George W. Goethals
Lecturer
Department of Psychology and Social Relations
Harvard University

and

Robert L. Trivers
Assistant Professor of Biology
Harvard University

Project Director: Anita Gil

INSTITUTION: Education Development Center, Inc.

DEPARTMENT: Social Studies Program

BUDGET: Total Granted: $2,535,990

Dates: 2/27/70 - Present

PROGRAM OBJECTIVES: Science Education Improvement

PROJECT OBJECTIVES: Development of a cross-disciplinary behavioral science course for use in grades 11 and 12.

PROJECT SUMMARY

OBJECTIVES

Exploring Human Nature, a year-long cross-disciplinary program of study, draws upon concepts, theories, and recent data from the biological and social sciences to enable students to discover some of the essential characteristics of being human. The four units of the course--Origins of Human Behavior, Childhood and the Community, Coming of Age: Managing Transitions, and The Individual in Society--are connected thematically by their focus on the interplay between human universals and cultural diversity, and sequentially by their investigation of the four major stages of the human life cycle: infancy, childhood, the transition to adulthood, and adulthood.

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Major Learning Objectives

1. Students will learn that human behavior is the result of the interaction of many forces: biological, environmental, social, and interpersonal. A full understanding of an individual's behavior must involve at least four distinct but complementary perspectives: the human being as a member of a species, as a member of a social network, as developing through a life cycle, and as functioning within social institutions.

2. Students will be better able to understand their own behavior and that of others. Students will learn to think analytically about their own personal growth and development, and to empathize with others by recognizing the universal patterns and differences that underlie individual growth and development.

3. Students will demonstrate broad knowledge of our own and other societies. They will identify both similarities (universals) and differences (cultural variations) in behavior. Drawing on cross-species as well as cross-cultural comparisons, they will be able to explain some of the bases for such similarities and differences.

4. Students will demonstrate an understanding that human behavior is amenable to scientific inquiry.

5. Students will acquire and/or expand basic understanding of the scientific method and reasoning skills through the use of an inquiry approach. This approach involves the scientific methodologies of natural science, anthropology, sociology, and psychology. Data are drawn from cross-species and cross-cultural comparisons, from personal experiences, and from information collected by students in their own communities.

6. Students will learn to use and evaluate theories from the variety of disciplines they are using by generating hypotheses and testing them against relevant data.

7. Students will learn to use a conceptual framework that allows them to explicate value questions, and to recognize values as an important determinant of human behavior. They will be able to study values systematically and to understand why people in a particular social context hold certain values.

8. Students will view learning as a shared experience through participation in cooperative classroom ventures and through the exchange of information that broadens students' knowledge and social skills.

ACTIVITY PLAN

Development of materials has been completed and the final formative evaluation is underway and will be completed during the winter of 1975-76. A search for a commercial publishers in in process.

ORGANIZATION AND MANAGEMENT PLAN

Final formative evaluation is being carried out by the staff of the Social Studies Program, Education Development Center.

UTILIZATION PLAN

1974. Leadership Training Project
Information Conferences

1975. Teacher Centered Projects
Information Conferences
Leadership Training Projects

Further utilization activities will depend on selecting a commercial publisher.

HISTORY

The National Science Foundation has provided support to EDC since 1970 to develop EHN. Initial support was provided based on a need, identified by the proposers, for cross-disciplinary materials in the behavioral sciences for secondary school level.

PERSONNEL

Principal Investigators: Irven DeVore
Professor of Anthropology
Harvard University

in association with:

George W. Goethals
Lecturer
Department of Psychology
and Social Relations
Harvard University

and

Robert L. Trivers
Assistant Professor
of Biology
Harvard University

Project Director: Anita Gil

D. 13. b: EHN (Panel 3): Project Director's Response to 10 Review Questions

NSF Staff Note: The project director for Exploring Human Nature responded in the somewhat different format below.

<u>Why was Exploring Human Nature Developed?</u>

1. <u>Exploring Human Nature emerged from student needs</u>. The basic goal of Exploring Human Nature is to help students understand the mainsprings of their behavior: to trigger new insights into their own actions and feelings, to deepen their understanding of their relationship with their own society, and to strengthen their sense of connection to people from other cultures. In other words we believe that given certain conceptual tools, behavior can be analyzed and comprehended, rather than seen as bizarre, exotic or random.

This is an important goal for students who are at an age in which they often see themselves as unique, singular individuals. By emphasizing shared patterns of behavior where these exist between generations, members of different cultures and members of different subcultures, the course says to students, "You are not alone."

Implicit also is the assumption that knowledge of human behavior is an important psychological anchor for adolescents growing up in a world of rapid social change. It is precisely at this time in their lives that many students are making personal and career choices that will affect their futures. They need and want an understanding of their own behavior to gain a sense of competency and control over their lives. As one student said, "Talking about behavior, there is no way you can help thinking of yourself--what motivates you."

In 1970 when development of Exploring Human Nature began, there was no program or course of study for high school students that addressed these specific needs and concerns. Students had inherited a world in which knowledge had grown exponentially, where generations and cultures appeared to be separated by behaviors, values and beliefs that were radically different, and where traditional school programs did not provide an organizing framework for interpreting varied life experiences or engaging students as active participants in the search for directions and goals.

2. <u>Exploring Human Nature was a response to educators' dissatisfaction with the structure of high school curricula</u>. In the sixties most high school curricula still reflected the university pattern of compartmentalized specialties composed of separate academic disciplines. As students inherited a world that appeared to be filled with "shreds and patches" of knowledge and information, so high school teachers inherited an educational structure that carved up reality rather than attempting to deal with it holistically. Education was viewed as the transmission of separate insights into life rather than the development of an integrated perspective. Many teachers and administrators felt that not only was the

traditional curriculum failing to address adequately student needs or provide a structure for ordering and assessing life experiences, but that they were experiencing increasing difficulty communicating among themselves. These factors reinforced our goal of developing a program that would bring together several fields of natural and social science to provide a model for the exchange of perspectives, ideas and resources--a forum in which student concerns would be spotlighted.

3. Exploring Human Nature was an attempt to bridge the two cultures. Both student and educator dissatisfactions were, in the final analysis, different reactions to a larger problem--one that C. P. Snow has called the "two culture dilemma." To the extent that the rift between scientists and humanists--between these "two cultures"--remained unresolved, the relationship between scientific knowledge and questions of human value and import remained obscure, and scientific literacy in the population at large remained more rhetoric than reality despite the tremendous dissemination of scientific information in the popular media. Moreover, exponents of the "two cultures" were impeded from talking to each other as much by their mutually unintelligible vocabulary as by the traditional structure of academic departments.

It was for these reasons and to meet these needs that a cross-disciplinary program of study for high school students that examined human behavior drawing upon information and methods of thinking from the fields of biology, anthropology, psychology and sociology was developed.

Does the Course Respond to Current Needs?

We answer with an emphatic "Yes," for the course emphasizes:

1. Development of scientific literacy and methodology. Students are asked throughout Exploring Human Nature to participate actively in the methodologies of the behavioral sciences--observation, experimentation, interviewing, using photography and naturalistic film as data, interpreting and analyzing. They are given the opportunities to grasp and employ the fundamentals of the scientific method of inquiry, to develop skills of observing behavior, to order and interpret observations, and to develop hypotheses that are then tested against new data.

For example, the skill of hypothesizing is called upon early in the course and continues throughout. In Unit 1, The Origins of Human Behavior, students are asked to analyze and evaluate the results of playing out the Natural Selection Experiment in different environments. In Unit 2, Childhood and the Community, they hypothesize about the relationship between types of activities and the development of certain personality traits in childhood. They test their ideas against data from other cultures, and apply those hypotheses that seem valid as they design their own world of childhood for the future.

Students expand their understanding of the scientific method in Unit 3, Coming of Age: Managing Transitions, by learning to use and evaluate various theories on the dynamics of adolescence. They analyze individual

case studies, and test the explanatory power of different theories in helping them understand the realities of their own transitions from childhood to adulthood. In Unit 4, The Individual in Society, they integrate the theoretical perspectives of the course and the hypotheses they have formed along the way in solving larger problems in community design.

By participating in these and other classroom activities and sharing information throughout the year, students replicate the processes of science and the scientific method in the advancement of knowledge.

2. Personal and National Priorities: In order for students to become effective and knowledgeable participants in their own communities and nation, themes and subject matter of interest and personal usefulness to young adults as well as national educational priorities guided the selection of core program materials.

Specifically, Unit 1, The Origins of Human Behavior, enables students to examine the relationship between their biological makeup and everyday actions. In doing so, it provides them with a sense of commonality and community with other living creatures, and lays the groundwork for considering the universal heritage of all peoples. In this time of increasing global diversity and unrest, students explore the basic needs, drives, and capacities that exist despite social or cultural boundaries.

Unit 2, Childhood and the Community, examines the socialization process in different societies and the importance of early learning environments and experiences for the later development of the individual. It prepares young people for effective parenthood (whether or not they ever assume this responsibility) by enabling them to investigate how child development in different societies is affected by the role parents and other caretakers play and the way social organization influences and is related to patterns of childrearing. The need for information about effective parenting is immediate as young people in the United States often are separated from their parents, grandparents or other support groups when they begin families, and because significant numbers of teenagers are undertaking early childbearing and childrearing.

Unit 3, Coming of Age: Managing Transitions, brings together the biological insights and social perspectives of Units 1 and 2 to help students untangle the often confusing emotions, social pressures, and societal demands of "adolescence." Stressing individual variation as well as common growth tasks, the unit relates how and in what ways biological maturation, social organization and personal life history intersect at this period of life and provides students with the opportunity to assess the relevance of different theories of adolescent development to help them understand their own experiences as well as the experiences of young people from different cultures. At an age when adolescents often feel alone, alienated, and different from everyone else and are seeking new directions for future growth and development, this unit underlines the common experience of attaining adulthood.

Unit 4, The Individual in Society, addresses one of the most critical concerns of high school students today: How can I know what work role is best for me? What implications will different work choices have for my adult life? By examining the nature of work in the United States, the distribution of different work rewards and providing a variety of data and opinions about why people choose different work roles, students have an opportunity to assess their own needs, choose the goals they might pursue in the years ahead, and consider the possible implications of these choices. At a time when many young people have little idea what adults actually do all day at work, the unit provides comprehensive and realistic views of many different work roles and options available in America.

3. A Cross-disciplinary Resource Intended to Generate Market Interest. Most significantly, at the time Exploring Human Nature was developed there were no courses available to school systems that were explicitly designed to meet the student, teac... ...nd scientific needs described earlier. Nor were existing courses foc... d on important and meaningful questions about human nature. Recently, however, several readers dealing with human behavior targeted for high school have appeared on the market, indicating the interest of publishers in responding to the need for materials in this area.

Issues of Content, Pedagogy, and Implementation

Exploring Human Nature, as a course whose pedagogical structure rests upon raising fundamental issues of human behavior open to scientific exploration and on developing systematic and empirical approaches to the investigation of these issues, provides students and teachers with opportunities to interact in new and exciting learning partnerships. It is clear, however, that precisely because EHN is a course built on the frontiers of knowledge, it presents teachers with new challenges in dealing with subject matter and innovative pedagogical strategies; it also presents potential publishers with various implementation concerns.

1. Teaching a Cross-Disciplinary Course

Most secondary school teachers are "experts" in one or two subject areas. In Exploring Human Nature, which draws on data and theories from four disciplines, teachers often are at the same level of subject matter expertise as their students and become co-learners in the classroom. To provide teachers with an introduction and opportunity to investigate Exploring Human Nature content, concepts, and pedagogy as well as a chance to share their insights with others in the field, a teacher-training program was developed to accompany the course. The components of the program are:

Workshops for teachers. Following the outline of the course sequence, a series of optional seminars are available for use before class work begins or during the school year, to provide an opportunity for teachers to

increase their skills and understanding of the course's scientific perspectives and pedagogical strategies.

Sources for Teachers. A loose-leaf booklet containing theoretical and methodological background readings from the course's four disciplines--biology, sociology, psychology, and anthropology.

Community-Based Leadership Models (Parent/Community Seminars). One measure of the success of a program is the extent to which the knowledge transmitted and developed in the classroom generalizes to students' experiences outside school. This goal means that parents and other community leaders are inevitably involved in the learning process and that the socially responsible course provides a mechanism to enable them to learn about and participate in the experiences their children have in the classroom. To help meet this need, a series of issue-oriented forums were developed to enable parents and community members to participate in the EHN experience.

2. Commercial Publication of a Multi-Media Program. A variety of print materials (four student texts, teacher guides, simulations, teacher workshop kits, etc.) and media (filmstrip, 3 1/2 hours of film) are included in the Exploring Human Nature program. These materials were developed, designed, and evaluated as being effective in helping students gain new insights into human nature. However, commercial publication of a year-long, multi-media course presents particular challenges to commercial publishers in designing new marketing strategies, training salespeople, and providing professional and technical assistance to users.

At the initial publisher's conference held last year, concerns about the multi-media nature of the program, the delivery of support services, and the packaging problems of such a variety of learning resources were raised. The general consensus was expressed in one publisher's comment: "It's a course that I would love to take or teach, but not try to sell."

3. The Pursuit of Science vs. Local Community Values

Bringing together data from a variety of disciplines not only involved presentation and organization of new information, but also required that we select the most representative and productive theories (as identified by course scholars) from each of the disciplines that would generate meaningful inquiry and learning. During the course's development the following assumptions about human behavior and scientific inquiry guided our work:

1) Human behavior follows orderly patterns that can be discerned through observation, experimentation, and research.

2) These orderly patterns can be perceived and understood if we apply to the study of human behavior the scientific method in its most general sense.

3) Different aspects of human nature are best understood by combining theories, concepts, and methodologies from different disciplines. Thus, Exploring Human Nature seriously attempts to bring together diverse insights from the fields of biology, anthropology, sociology, and psychology in exploring interesting and important aspects of human behavior.

4) A comparative approach to human behavior--sometimes looking at animal behavior, sometimes investigating different cultures--increases understanding of one's own behavior, and culture. It also encourages students to develop a greater sensitivity to and appreciation for human diversity.

To the extent that these assumptions are not shared by local communities, the theorists and points of view presented in the course may appear at variance with strongly held beliefs and attitudes of some community members. This can manifest itself in concern about possible effects on students.

For example, the theory of natural selection is perhaps the most widely held explanation by biologists for the origin of many behaviors and characteristics of life that are considered human. Yet many people hold religious convictions that do not support the value of this theory. There may also be fundamental disagreement with the major social science perspective that behavior is both orderly and predictable under certain circumstances. Many people believe that human behavior is completely self-determined and that a scientific analysis of behavior is deterministic.

We are presently experiencing a climate of opinion in which science and its assumptions are being challenged. The rational inquiry essential to the growth of new knowledge is being viewed by some as destructive of the moral and ethical traditions by which society is preserved. One of the fundamental beliefs of the developers of Exploring Human Nature is that truths about human behavior will be discovered somewhere between these two positions and that knowledge progresses by open inquiry and the free exchange of ideas.

D. 13. c: EHN (Panel 3): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

There is no documented evidence provided to the panel concerning the need for these instructional materials. The project has assumed that there is a general need for this type of interdisciplinary course. The original project proposal referred to the need to integrate the natural and social sciences into one course. Also, the proposal referred to the "dull" and "uninteresting" format of much of the educational material that was currently available.

The project developers believed that a general need existed for the materials developed. The project proposal justified its approach as follows: "until we can begin to convey the excitement of our new understandings of human behavior and motivation to students at a pre-college level, we will continue to produce citizens with exemplary technical sophistication and unfortunate social naiveté."

Researchers claim the following needs: "to trigger new insights into the students' own actions; to deepen relationships with their society; and to strengthen a sense of connection to people from other societies." Documents justifying these needs were not provided to the panel. However the broad objectives and goals of the course reflect many of the current trends in social studies program development. Many educators believe that there exists a general need for social studies materials which do develop skill/process objectives.

It is impossible for this panel to determine how many students these materials would reach. However, its conceptual complexity, level of abstraction, and reading level would possibly make it too difficult for some students. The content of this material would successfully challenge the average student. It is not boring, and unlike many school text books, it might tend to arouse the curiosity of the student.

Whether any alternative instructional materials are available can not be satisfactorily answered. This material could conceivably be an alternative to a combination of other courses or programs such as sociology or psychology. Identifying other "satisfactory alternatives" is a value decision which would have to be made by students, parents, school personnel and communities.

There are needs for courses dealing with human nature in secondary schools. These instructional materials would introduce a student to one scientific approach to studying behavior. The four units deal with questions important to students. The questions cover a wide spectrum, from analyzing foreign cultures to the role the male plays in the family.

Schools, community groups and parents should be aware of the fact that some of the content and processes included are controversial issues among both scientists and lay persons.

Question 2: Is there a market for these instructional materials?

The developer does not provide data which indicate that there is a need for these materials. However, there is an existing place for this program in the social studies curriculum.

The developer readily admits that there are some dissemination problems which may arouse opposition to the implementation of this program. The materials present a challenge to publishers to design new market strategies, train salespersons, and provide professional and technical assistance to those using the program. The multi-media aspect of the program and the inclusion of controversial material has limited publisher's interest in the program. At this time, no publisher has offered a draft contract to NSF. NSF staff states that verbal communication is in progress with a publisher.

The developer's views on human behavior and scientific inquiry are not shared by some local communities. Furthermore, the theorists' points of view presented in the course appear to be at variance with strongly held beliefs and attitudes of some community members. It is highly questionable whether this program would be widely used if it were available on the market. However, much information necessary for a comprehensive evaluation of the marketing aspect was not available.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The instructional materials are clear and form a cohesive package. However, the rationale for the sequencing is not clearly stated. Unit 1 is not explicitly related to Units 2 and 4 in that it emphasizes genetic processes whereas Units 2 and 4 emphasize socio-cultural processes. Units 2 and 4 ignore problems raised in the first unit such as physiological problems of health, reproductive rituals of men and women, and survival in different environments.

The assumption that knowledge in itself helps students with their own personal problems is not justified in the course materials. There are many inferences that might be made by students, teachers, administrators and parents that we cannot predict. Some possible inferences are: behavior cannot be controlled or modified; any social behavior can be justified; and eugenics may be a desirable social policy.

There is a need for students to learn about the development and evolution of behavior and a need for students to understand their behavior, but this educational program may not answer both needs.

Question 4: Is the content of these instructional materials scientifically correct?

Units 2, 3 and 4 of the instructional materials generally represent the mainstream of behavioral science. Important examples include the five

theories of adolescence in Unit 3, the probabilistic approach to natural selection in Unit 1, the differences and similarities in human behavior discovered by cross-cultural comparisons. The ranges of alternatives of careers in Unit 4 and marriages in Unit 3 are presented in a scientifically accurate fashion. One important questionable point of scientific content is the emphasis on the genetic determination of behavior. In Unit 1 an example is given of "helpfulness" as a genetically determined characteristic. Although this is a hypothetical example, it may lead to an erroneous inference on the part of the students.

The instructional materials are scientifically current. The use of probability and models is consistent with current behavioral scientific practice. Exploration of different sex roles, male competition and female choice, the role of women, and the sources used in the print and film materials all are drawn from current sources.

The materials are designed to create a scientifically literate population, not to train future scientists. The emphasis is on the students actually working on their own with the concepts and problems considered. There is a de-emphasis on formal methodology, and formal bibliography.[2] The materials are presented in a visual fashion designed to attract the interest of the reader. The topics are chosen to be close to the experiences of most students who will be using the materials.

Since the materials touch upon almost all the behavioral sciences, they cannot possibly cover all aspects of the fields. The materials quite properly do not attempt to achieve this impossible goal. Many important topics are not covered. For example, there is no treatment of social class, the evolution of cultures over time and little discussion of the function of social norms, although the importance of values is discussed.

The report, "National Science Foundation Curriculum Development and Implementation for Pre-College Science Education," has dealt with an unavoidable problem in developing curriculum materials in the behavioral sciences when it quotes the Advisory Committee on Science Education's conclusion: "NSF has a continuing role in science curriculum development at the pre-college level; NSF should not avoid controversy at the expense of educational and scientific value..."

These materials are consistent with this point of view. Some segments of the population, both lay and scientific, will no doubt find them controversial.

Question 5: Is the content of these instructional materials educationally sound?

There was general agreement that there are likely to be some adverse reactions to the materials. Some will occur because of inclusion of profanity and examples of behavior which some people will consider immoral in required readings. Other objections are likely to stem from such things

as a deterministic view of man which conflicts with the Judeo-Christian ethic, behavior modification techniques, and invasions of privacy through the use of interview techniques. There may be a feeling that the school is interfering in areas which are the parents' domain such as personality development, values, etc.

An examination of the student dialogue by those who have just taken part in the Natural Selection Experiments (From Many Perspectives, p. 59), seems to indicate that the experiment could lead to an acceptance of a hereditarian viewpoint of behavior. The eugenics exercise (Unit 1, Teacher Guide, 159-163) could lead students to accept eugenics as a means of population control. A further negative reaction might stem from the expectation that the teacher should assume a counseling role.

There is a need for a reading level evaluation to determine if the level is too high.

There may be unfavorable pupil reactions from those with strong religious and moral beliefs and from those who resent inquiry into their personal values. The inclusion of emotion-laden material and activities could cause problems for some students. Even some students who feel that they are coping with their personal problems may begin to doubt themselves after viewing some of the negative case material.

Because of[3] the requirements for summer workshops, teacher training, and the enrichment follow-up programs outside of the local school system, there seems to be little community involvement in content or teacher preparation.

Favorable reactions will stem from many teaching source materials, the variety of teaching strategies, the organization of the teachers' guides and the effort to eliminate stereotyping. We are unable to judge whether these favorable reactions will outweigh the adverse ones because of a lack of sufficient copies of the curriculum packages and time pressure.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The panel has mixed reactions with respect to desirability. Members agree that the materials will accomplish two of the results anticipated by the developers--that they will deepen the student understanding of their relationships to their own society and of its likenesses to, and differences from, other societies. Some members of the panel doubt that the materials will trigger insight into the student's own actions; others think they will.

Many fears were expressed by panel members of possible unintended consequences. Perhaps the most important was that some of the reading materials and student exercises may be emotionally upsetting to students whose situations in life are not usual--illegitimate[4] children, children of divorced parents, children with a parent in prison, and the like. The critics, however, were sure that the developers did not intend to slight this problem.

A more specific objection raised by several panelists was that the exercise in which students follow through the process of eugenic selection tends to give sanction to this principle.

There was also some feeling that the emphasis in Units 1 and 3 was on children with problems to the neglect of discussion of those who adapt successfully to their life situations. Some, but not all, panelists felt that the materials fail to make sufficiently clear the distinctive nature of humans in the hierarchy of species and that their ability to manipulate symbols distinguishes them sharply from other species in thought and action, conferring upon them a dignity that needs to be emphasized.

On the positive side, the panel thought there were[5] few examples of stereotyping by sex and race. They also were impressed by the degree to which oral and visual materials are employed. There is no doubt that the text materials are attractively put together.

One weakness that was pointed out is not a failure to meet objectives, but the absence of an objective; i.e., to give opportunity for written analysis. These interesting materials would give opportunity for challenging written assignments.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

The following statement was added by four panel members (McGough, Engstrom, Lineham, and Campbell):

As a side effect of providing special training, preparatory time, and psychic reward to EHM program teachers, other teachers might tend to feel discriminated against. A staff morale problem might result.

General response of the Panel:

A wide variety of problems must be faced and overcome if this program is to be implemented on a large scale. Its adoption by a district would require substantial additional investments in materials, teacher in-service education, and community preparation.

Participating teachers would generally require additional knowledge in such fields as anthropology, sociology, psychology, and in the biological fields of physiology and evolutionary theory. Also, they would need advanced training in the methods of social studies such as the use of inquiry, case studies, role playing, simulation games, and open-ended materials. The successful use of this program would require an unusually competent teacher.

Providing for the training of such teachers would cost the school district a considerable sum of money. In addition, the training of substitutes and replacement teachers could make teacher training an ongoing program cost.[6]

It is likely that the extensive daily preparation required to teach this program would mandate the allocation of more preparation time during the school day. The "freeing up" of each teacher for one additional period per day would cost approximately 20% of a teacher's salary per year.

The relatively high cost of the package might discourage some schools from adopting the program. The per student cost will be higher than the costs of standard secondary school textbooks, although this panel cannot estimate the actual per student cost to a school district.

The values orientation of this program would probably necessitate the provision of an alternative course, if this were to be a required unit. Providing such an alternative would be costly, but would not be necessary if EHN were provided as an elective course.

Question 8: Are the costs for implementing these instructional materials reasonable?

The adoption of this program would probably cost a district more than traditional programs. There would be ongoing costs such as training replacement teachers and renting or replacing software.

School districts could possibly develop alternative interdisciplinary programs, using cross-disciplinary team-teaching techniques and currently available materials. However, we are not saying that such a locally developed course would be completely comparable to the EHN, only that it would be an alternative to it.

In a general discussion of the cost of implementing a controversial course, the social costs of creating conflict within the community must be considered. For example, introducing a controversial program like EHN could possibly result in a loss of support for the local school, budget defeats, and law suits.

The cost of implementing this program is reasonable to the degree that a community is:

a. Open to value exploration by students through organized school programs and behavior modification;

b. Supportive of its school system;

c. Affluent enough to support this program;

d. Motivated to allow experimentation with innovative programs.

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Question 9: Is the management/organization plan adequate for producing these instructional materials?

To the best of our knowledge, the overwhelming input has come from scientists in the preparation of material. Teachers were involved in formative evaluation during the development of the materials, as field-test participants, but were not part of the materials development team. (Untested questions are suggested for use by teachers in the Overview of the Course and Goals and How to Assess Them, the guidebook for teachers, p. 53). As far as we can tell, there has been no input from lay people.

There was a budget item for internal evaluation in the original proposal. We presume that this money was spent as indicated, since EDC is a well-known organization of professional competence. The EDC staff has made site visits to their field test stations. They have held teacher training institutes and community education programs. However, we have no evidence of the details of the internal monitoring, nor do we know what changes in the material development process have been brought about by these activities. From the original proposal, the current proposal, the summary statement or other materials made available to this evaluation team, we have found no evidence of any independent or outside evaluation.

We have no information on which to judge whether the administration of the project is top heavy, too thinly administered or neither.

We have seen the following materials and/or information provided to NSF: the original proposal and the current proposal; all the units--students and teacher materials, most of the films*, a summary statement to this team and two extensive communications between NSF and EDC. As far as we can tell, the NSF staff feels the formal and informal sources of information provided have been adequate. We have no reason to doubt this feeling.

We also wish to comment on the elegance of the experimental materials. The cost of these editions is excessive--glossy, heavyweight paper, type setting; etc. Although some visual attractiveness is an important part of the course materials,expensive production is not warranted in experimental editions. Among other things, the present experimental edition sets a floor on the costs which will ultimately have to be paid by users--whether they are commercially published or published by the developer. We also note that a 100_ overhead cost was requested. If allowed, this was certainly a factor in the costly nature of this project.

This question was difficult for this evaluation team, given the time and information available. NSF staff, or other monitoring groups are better prepared to make judgements on these questions based on auditing, site visits, and other means.

* Three films which appear to be quite important to this course were not available to the evaluation team; they are "Manhunters," "Rock-a-Bye-Baby," and "Is It Just Chance?"

Additional comments by Dr. Ethel Tobach:

1) Physiology, anthropology, sociology and psychology give necessary insights into human behavior as do history and philosophy. The characteristics of the human species as we know it today should indeed have serious study in comparative studies with other species, but the differences must not be overlooked. The evolutionary history of the speciation process that resulted in the human species is not yet more than a set of theoretical propositions. The discussion and presentation of one viewpoint about heritability of behavior is still only a proposal to be tested; yet the student is asked to work out the inheritance of behavior under selection pressures, without suggesting that other processes might also function.

The emphasis on evolutionary change through a simplistic relationship between genes and behavior (the latter viewed as "structual") as proposed by Lorenz, Tinbergen and others cited in the Unit, has been challenged by Schneirla, Lehrman, Moltz (psychologists); Lewontin, Hirsch, Dobzhansky (geneticists); Leacock, Alland (anthropologists). The presentation of only one point of view is reflected in the failure of the authors to present data and analyses of the data to support the assumptions. The presentation is based on a dichotomy between "inborn" and "learned." This dichotomy has been challenged by those cited above and by some ethologists as well (Hinde; Bateson).

Although the authors state that "genes are chemical structures" they do not describe the developmental genetic process: genes are defined by their expression in particular functions given certain developmental conditions. The authors conceive of genes as "controlling physiology and thus behavior." The inferences that might be made on the basis of this formulation are stated below.

The equating of different human cultures and different animal groups is another example of the underemphasis of differences among species. The assumption that animal behavior increases the understanding of one's own behavior is at best tendentious.

2) How is it possible to create a scientifically literate population without introducing students to formal methodology and bibliography? "De-emphasis" is not a helpful word here; perhaps "insufficient use of... ?"

3) This is not clear. Should "Because of" read "Given"?

4) "Illegitimate" should be "born out of wedlock."

5) Please add "relatively" at this point.

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6) The following statement was added by four panel members (McGough, Engstrom, Linehan, and Campbell):

"As a side effect of providing special training, preparatory time, and psychic reward to EHN program teachers, other teachers might tend to feel discriminated against. A staff morale problem might result."

D. 13. d: EHN (Panel 3): Individual Panelists' Responses to 10th Review

Question: What are your general impressions of the curriculum?

Panelist: Dr. Douglas Alder

These materials are handsome. The developers have been savvy in the pedagogical strategies they used. I am only disappointed that they stayed so close to the MACOS model. The materials are too expensive to be widely adoptable and the content is so controversial that school systems will be inviting a community fight if they do adopt them. The saddest situation is that the above limitations have got them in the same publishing corner as they were with the MACOS curriculum. No publishers will touch it except the one that published MACOS. The EDC staff is a first-rate professional organization but I wish they could have disciplined their tastes. The field test materials were produced in an expensive format that rival some materials in their final published form. I understand that they know that media use and layout are crucial to the learning effectiveness of field test students but the "slick" nature of the field test copies almost makes the EDC into a publishing house. Some might even become suspicious that the EDC considered the possibility of not attracting a publisher so that the materials were set in a format that could be used by merely printing volume copies of the field test materials and becoming their own disseminator. This is hardly the business that NSF should be in--providing an alternative to the free market.

The developers exhibit a zeal to introduce the behavioral sciences into the High School curriculum yet they have chosen an approach that is likely to backfire.

Panelist: Dr. Robert C. Angell

I regard this as a scientifically sound, innovative, and imaginative course. It is especially well put together from different disciplines and uses excellent teaching aids - pictures, films, and analytical exercises. The teacher's guide is well done and gives much of what is needed to handle this unusual course. Though this course may cause some community complaints, I believe the students will find it exciting and fruitful. There is no existing course that covers the same ground. That ground is highly significant and this course covers it admirably.

The one great drawback will be the expense to the school of the whole package - films, texts, teacher's guide, etc. I am afraid many schools will not be able to afford it.

If, as an elective course, parents are given the opportunity to see it before their children take it, I doubt that there will be serious community complaints. I therefore feel that the developers should not be required to revise it extensively. There will have to be opportunities for teachers to get training sessions if the course is to reach its full potential in the classroom.

Panelist: Mrs. Alethea Campbell

No comments submitted.

Panelist: Dr. George W. Carey

My impressions concerning EHN are best expressed in a general form.

1. The material simply will not be well received in the local communities. I also believe there will be difficulties in securing a publisher. The implementation process will be costly and complex.

2. I find the materials are strongly prejudiced toward cultural relativism which very definitely opens up the possibility that the students will not come to appreciate the ways of life in their own culture and the values which they embody.

3. The materials are not new; nor is the approach. Most of them - or materials just like them - are used in a more sophisticated manner at the college level.

I concur most emphatically with the general panel assessment on questions # 2, #6, and #5 and the implications raised there.

Additional general comments

(A) Our initial group decision regarding procedure as a logical one given the circumstances: namely, five days to examine with thoroughness three major projects in the social science area, having to draft responses to nine general questions and sub-questions, and finally, having to draft responses to these questions in smaller subcommittees. Even though our procedures were reasonable ones, we did not have the time to complete our tasks. Our discussions in both the smaller committees and the group never were able to turn themselves very far from the questions that were put to us by NSF. The ten questions, in turn, overlapped and in many cases were redundant.

(B) Not all materials were available to us. In some cases, materials were available only in limited quantity which caused problems. This was true in varying degrees with all three projects under review, most so with respect to Exploring Human Nature (EHN) and Human Behavior (HB). In my judgement, this was a very serious shortcoming with respect to EHN, certainly the most controversial of these projects.

(C) With respect to the programs under review, one of the major questions that arose continually concerned need; that is, whether a need existed at the secondary level for courses built along the lines set forth in these programs. In this respect the following should be noted:

1) We were more or less forced to take the word of the project initiators relative to need. There was no way for us to determine need.

What is clear, however, is that need, as set forth in the proposals, was in large part confused with the presumed novelty of the approach. More exactly, in all proposals much was made of the fact that the existing high school social science curricula did not utilize the approaches outlined in the proposals.

While this is undoubtedly true in all cases, such a state of affairs simply does not constitute evidence of need. There are countless approaches to the study of man which are not utilized at the secondary level but from this it does not follow that the secondary curricula are deficient and in need of revamping.

2) Where need was shown in justification of one program through citation to surveys which reveal an alarming ignorance on the part of large percentages of the population concerning our basic constitutional system, the project itself was not directed to the alleviation of the deficiency. Quite the contrary. The CPE program expressly states that its chief value is its lack of emphasis on the formal institutions and processes of our government. In this sense, the whole project is an anamoly. Part of its justification rests on the political ignorance of the American people with respect to formal institutions, yet its thrust in no way would serve to rectify this condition. It would, in fact, make the situation worse if its program were implemented at the secondary level.

3) While need cannot be accurately assessed, there are bits of information that throw some light on the matter. For example, the EHN project, after the expenditure of 2.5 million, has only "interested" one publisher, the same one which published MACOS. One would think that, if there was a real need, a number of commercial publishers might express serious interest. Moreover, the CPE project is hardly revolutionary and the materials which it offers, although highly biased, are far from original in approach and could easily be duplicated by any number of commercial publishers at a fraction of the cost. Indeed, at the college level, such materials have been produced, albeit in more sophisticated form. This fact tends to undercut the claim of need.

(D) The CPE project by all evidences is fairly far along (more than 1.2 million expended to date) and the fact is that no adequate appraisal of its output has yet been made. This is, in my judgement, a very serious shortcoming. There is need for a review by disinterested political scientists, i.e.. political scientists not connected with the project in any way, past or present.

(E) The ten question format designed by NSF simply precluded panel consideration of certain basic matters such as those I have mentioned. Those who read the committee report should at least be apprised of this fact.

Panelist: Mr. Coe Dexter

The Exploring Human Nature materials are innovative, high quality, sophisticated, instructional materials. Their successful use within a school district would require a high level of commitment on the part of the teachers, the school district, and the community. Any district using these materials should expect and prepare for a certain amount of controversy to result from their use. All appropriate segments of the community should be involved in the preparatory stages of initiating the use of these materials, as well as monitoring and evaluating the ongoing program.

In general, I believe that the development of these materials has been a worthwhile project of the National Science Foundation. However, I also believe that because of their cost, level of sophistication, and controversial nature, they will be actually used in relatively few school districts, and will affect a fairly small percentage of the school population.

In considering future funding of such curriculum development efforts, the NSF might consider the general recommendations suggested by this panel.

Panelist: Mr. David Engstrom

The Exploring Human Nature materials, in my opinion as a student, were well done. The reading level was comprehendable for the average student: The curriculum utilized such methods as group discussion, audio-visual, role playing exercises to stimulate the student's interest. The layout was attractive. However, the sequence of modules overlapped in some instances and in others, the following modules had no relevancy to the previous ones. Exploring Human Nature could also use more written exercises. The EHN curriculum with alternations would be an exciting course for the high school student to take. If this course was offered at my school, I would take it.

Panelist: Mrs. Verna Fancett

In many ways, Exploring Human Nature reflects current thrusts in social studies and this is to be commended. The program is interdisciplinary, concept based and thought-productive. It employs a variety of teaching and learning modes and techniques. The accompanying films are excellent.

It is extremely regrettable that some highly controversial content is included in an otherwise creative and exciting package. Such inclusion immediately reduces the number of schools and students who otherwise might have benefitted from it. Also, the confidence of teachers and the public in new programs is jeopardized.

I am in agreement with other panel members that we had insufficient time to do a thorough study of all materials.

Panelist: Dr. John C. Linehan

My appointed role on this panel has been to represent the administrators of the pre-college sector of the Public Schools.

The incomplete condition of the curriculum package made available for evaluation, both before our arrival (pre-study) and on-site, has made an accurate evaluation difficult and educationally frustrating.

The highly controversial nature of the content that was on hand is probably the main reason for my reservations as to the wisdom of publishing and disseminationg this course of study.

The costs of implementing this project in an average school system must receive consideration. The per pupil costs projected are not competitive with other competing materials.

It is my belief that this course of study, when introduced into many school curriculums, will be lead to parental disfavor and resistance, due to sections that seem to be an invasion of the parental domain. Administrators that are already involved with increasing community scrutiny and criticism, demands for budgetary reductions, increase in class size and now "a return to basics" will not consider adding a costly, unproven project to their school problems.

I commend the authors for the innovative format, yet question the advanced stage to which the project has been carried without determining the need and marketability of the project.

NSF has a well deserved reputation and prestige for its previous contributions to education, due to its experienced staff and years of experience. Any reduction in their role in this area would be a loss to all of education. NSF should be more completely involved with projects, from grant approval to completion and be properly funded to do this. In this manner, projects with little market value will be terminated at earlier stages of growth, or will be revised to meet market and public acceptance.

Panelist: Mrs. Kristine McGough

A course such as EHN deserves a lengthy critique. Unfortunately, because of a lack of complete curriculum packages for panelists plus an insufficient time to review the material, I will confine myself to my "general impressions," "personal feelings" and "recommendations." Wearing my "panel member" hat, with a sincere effort at objectivity and the ability to cope with group consensus, I find nothing particularly outstanding in the material. The slick packaging is not new - many other curricula have similar well-illustrated books, films etc. The "package" might even be a minus - so much material is being developed in this mode that

one wonders if students of the future will be able to deal with a plain printed page. Unit 1 appears to deal with one particular theory of human behavior - to the exclusion of others - this does not seem to be good educational practice. Unit 3 seems similar to materials already existing in such materials as those by Guidance Associates used in Family Life Classes as well as the type of material appearing in the Contact series. On the positive side, the exposure of students to the models of adolescence by Erickson, A. Freud, Hollinshead, etc. seems like a good idea.

Removing my "hat" and putting on my "apron," from a mother's viewpoint, my feelings about the course are extremely negative. I feel the material does not view man in a proper light - the genetic theory, in my eyes, downgrades the concept of man as a spiritual being with free will. I find the student exercises to be offensive - the Natural Selection Experiment, with its spinner and gimmicks, seemed to reduce students, as evidenced by the dialogue in "From Many Perspectives," to sitting around callously discussing who "made it" and who didn't - this is not a personality development I desire for my children. In the Teacher's Guide, Unit 1, the teacher is given a treatise on over-population with several alternate solutions to the problem. However, the suggestion to the teacher is to have the students design a program of eugenics - it does not take a Ph.D. to get the point. I could probably go on for pages with my negative feelings about this course but I will refrain. Generally, I feel EHN goes into value areas which are the province of the home and the church. When asked to serve on this panel, I questioned my role since I was a nonprofessional. I was told that it boiled down to "Would you permit your child to take this course?" My answer, and I believe that ~~of~~ many other parents in America, is a resounding No!!

On a broader issue, I am distressed that my tax dollars were used to develop this material. I have been led to believe that because of the tremendous funds already invested in EHN this project will go forward regardless of the panel report. If so, it is most unfortunate as it will probably cause another MACOS controversy. I feel the Federal Government should involve itself in curriculum development only in the most extreme cases of national need. In my opinion there is no such need for this course--in fact the American people would probably be better off without it.

Additional general comments:

I am basically in opposition to federal involvement in curriculum areas - by its very nature it tends to remove control of education form the local community. By the time the community has a voice in deciding whether or not to adopt a given curriculum, many millions of public tax dollars have already been spent.

As a layman, it was startling to read of the elaborate diffusion projects involving NSF curricula. Although there is much talk of "needs assessment" in the grant proposals, the diffusion projects seem to contradict this.

At the risk of sounding like the little boy in "The Emperor's New Clothes" who is pointing out the obvious - if there was such a great national need for some of these curricula, why does the government have to spend tax dollars to "sell" them to the citizens? In the case of some curricula I've seen, we could be in the position of financing the man who is selling us the snake oil. As a parent I was shocked to see the lack of parental input at the proposal stage.

Since I realize that there may be instances in which the resources of the Federal Government may be useful in the development of certain curricula, I wonder if this might not be handled better by funds to the states with close monitoring by NSF and a legal requirement for citizen involvement during the development stage. Also, since many federal projects are experimental in nature, I see no way that proper needs assessment can be carried out without involving parents. Since it is our tax money and our children who are used, it seems to me we should have a voice in deciding whether we "need" a particular program.[1]

Panelist: Dr. Michael K. O'Leary

There is an important and continuing role to be played by NSF in supporting innovative social science materials that are sorely needed in American education. However, projects such as EHN, CPE, and HB should be funded only on the basis of documented needs, supported by evidence systematically gathered from social science teachers and local community representatives.

In funding proposals and in monitoring development NSF should concern itself with the market for the materials produced. This entails satisfying the criteria of (1) meeting identified needs, (2) flexibility of educational uses, (3) low cost, (4) quality of the materials and (5) avoiding widespread rejection by teachers, administrators and the communities in which the materials will be used.

Projects funded by NSF should pay equal attention to the development of both the teacher and the student materials. Teacher's guides should be developed which minimize the need for specialized, costly in-service training and which enable teachers to implement the program adequately, even if they are not specialists in the discipline being covered.

Panelist: Ms. Juliana Podraza

EHN has many sound, educationally beneficial aspects which would enrich a social studies program. The benefits, however, are overshadowed by several disadvantages. This extensive program may be purchased by few schools due to the expenses involved in both purchasing the materials and in providing the necessary teacher training.

The teacher manuals would need revision which would enable the teacher, also any substitute teacher, to implement the program more effectively.

Those portions of the program that evoke objection from the local communities should be eliminated to facilitate acceptance of the program. It seems that those portions causing the objections are in the teacher materials, therefore, this would not effect the content of the curriculum for EHN.

Since no publishing company at this time is willing to bid for this program, NSF should consider modification of both the materials and the price which would warrant a wider acceptance and purchase of the materials.

Panelist: Dr. Ethel Tobach

In answering question 10, I believe a statement of my rationale for approaching "Exploring Human Nature" and "Understanding Human Behavior" is necessary.

1. The science of behavior should be taught through the integration of concepts of evolution, development, physiology, anthropology, sociology and psychology.

2. Today biology, anthropology, sociology and psychology as academic disciplines deal with many aspects of behavior, both on the human and nonhuman animal levels. All are concerned with ecological issues, and thus by implication, problems of adaptation and environmental processes.

   It is thus difficult to integrate the professional disciplines in the development of teaching materials (see Dr. John K. Bare's application and statement about the 1967 conference called by APA) because each discipline is interested in developing its own educational program because of needs to respond to the professional futures of the membership of the professional organizations.

3. Behavioral science, more than any other science, is intimately related to societal processes--its value systems, its governmental and community organizations, its codified forms of responsibility between citizen and government. Therefore, it is most important that in developing programs for teaching any one of the behavioral sciences that all those concerned be involved: students, teachers, educational administrators, parents, governmental agencies and administrators, and <u>institutions which train teachers</u>.

   These populations should be involved in every aspect of the teaching-material development: conceptualization of a possible need; determination of the need; conceptualization of ways to satisfy the need; evaluation of the success with which the need was met; future planning.

4. The educational process, once it is the product of the integrated activities of the groups mentioned in "3" above, should then be carried out by individuals who are trained in presentation of the substantive material. The learning process should have the support of specialized personnel to aid in the activities which guarantee that the students and teachers are operating at their maximum efficiency; if students or teachers require individualized instruction or counselling for personal emotional-social problems, that kind of professional service should be available to both. The teacher and the student should not stand in any type of clinical relationship to each other. It is hoped that the teacher will be a true educator, sensitive to the behavior and needs of the student and able to maximize the student's learning. Where the teacher is unable to do so, the possibility of eliciting help from other resources should be real.

Therefore, the material developed for the teaching of behavioral science should be organized to present the student with the currently accepted information about a field of knowledge; where that information is still debatable because questions have been raised about the scientific validity and reliability of the material, the students and the teachers should be made familiar with the issues involved, the most widely held viewpoints on the matter and the need for further research to resolve the issues. THIS IS THE MOST IMPORTANT THING THAT STUDENTS CAN LEARN ABOUT ANY SCIENCE: THE STUDENT IS BEING TAUGHT THE PRESENTLY ACCEPTED KNOWLEDGE--AND SOMETIMES SCIENTISTS THEMSELVES ARE NOT IN AGREEMENT. THE STUDENT CAN THEN BE LED TO UNDERSTAND THAT THERE IS PLACE FOR THE PARTICIPATION OF NEW SCHOLARS IN THE ELABORATION OF NEW KNOWLEDGE.

REMEMBER: "THE WORLD IS ROUND."

I also recommend that the relationship between the programs in "Exploring Human Nature" and "Understanding Human Behavior" should be reviewed and integration between the two realized.

1. These two programs should be integrated and should represent the work of the evolutionary biologist, the developmental biologist, the geneticist, the anthropologist, the psychologist and the sociologist. There is too much overlap among the current curricula in the different disciplines. If the various disciplines cannot work together, I would be so didactic as to say that no discipline should receive any support for a program that is already represented in the integrated program. The disciplines should be aware that if they cannot work together, they cannot get support alone.

2. In both programs, there is too great a possibility that by appealing to the self-interest of the student in personal problems, the substantive materials of the disciplines are under-emphasized and the more "romanticized" aspects of

behavior will be overemphasized. The material that is being studied should enlighten the student about the relationship between individual and social behavior, and should inform about ways in which individuals can receive the guidance and counseling that might be wanted. However, the classroom work should not be a substitute for that kind of professional service.

3. As a comparative psychologist (evolution of behavior) I am most distressed at the kinds of modules chosen in the Human Behavior program and the fact that this area of psychological science was not represented except in the EHN. Please be aware of my personal bias in this respect.

Finally, I would like to make some general statement about the activities of the National Science Foundation and its role in science education. In order to do so I would require more information than I have available to me. Some of my questions are:

1. What is the relationship between the Office of Education and the NSF function?

2. Has standardization of scientific material to be disseminated been discussed by federal, state, and municipal educational agencies?

3. How much relationship is there between these NSF activities and curricula in teacher-training institutions?

Without the above information my remarks are undoubtedly limited in their usefulness. However, the questions indicate my concern. First, I am in favor of a standardized science curriculum in those areas of science where controversy is at a minimum; in this instance the definition of "controversy" is moot. (Please see my other remarks about the sensitivity of the interface between society and all behavioral sciences.)

Second, I believe the efforts being made by NSF are to be encouraged and supported. They do not go far enough. Integration among NSF, Office of Education, and above all teacher-training institutions is essential.

I am grateful at having had this opportunity. I hope that my "learning" experience on this panel resulted in my being constructively contributive to the NSF and to science education.

1) Additional comment by Mrs. Kristine M. McGough:
"I am concerned about the ethics of student participation in experimentation."

D. 14. a: HB: NSF Descriptive Information

PROJECT TITLE: Human Behavior Curriculum Project (HB)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: John Bare

INSTITUTION: American Psychological Association

DEPARTMENT: Carleton College, Northfield, Minnesota

BUDGET: Total Granted: $676,408

Dates: 1/1/74 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Development of modular material on human behavior for use in high school courses on psychology and other fields.

PROJECT SUMMARY

OBJECTIVES

Goals and objectives

1. The goal of the project is to improve the quality of instruction in human behavior in the secondary school.

2. The specific objective is to develop, validate, and disseminate 30 modules for instruction in human behavior, a module here defined as a self-contained unit of 2-3 weeks duration.

3. The target audience for the modules is those students with the range of ability typically found in grades 10-12. Because instruction in human behavior now occurs largely at the 12th-grade level, it is expected that the modules will have their greatest use there. On the other hand, since grade level is not a good measure of individual ability, the audience may be thought of as secondary school students generally.

ACTIVITY PLAN

Project time-table

1. During the first year (1974): the project office has been set up; the Steering Committee has met and suggested a list of topics; widespread publicity has been given to the project; the module topics have been described in both the HBCP Newsletter and in the APA Monitor; a Module-Design Handbook has been published and distributed; and development work has begun on several modules.

2. The design, local testing, revision, two national testings, and final revision of a group of modules are expected to take approximately 18 months. During 1975 and 1976, the following accomplishments are expected:

completion of design, local testing, revision, first and second national testings, final revision, and production of the first five modules;

completion of the design, the local testing, revision, the first national testing and subsequent revision of the next ten modules;

beginning of the design of the last 15 modules;

the mounting of the implementation effort;

the supporting efforts for the accomplishments above, including the solicitation and selection of the modules, the monitoring of their production, the design of the evaluation instruments and the particulars of the evaluation methodology, editing and revising the materials in the project office.

ORGANIZATION AND MANAGEMENT

1. Responsibility for policy-making and planning is lodged in a steering committee of 15 prominent behavioral scientists appointed by the American Psychological Association's Board of Directors.

2. Responsibility for advising on the school systems, the schools, the students, and the problems one encounters in these areas is lodged in the Advisory Committee. Their first-hand information about education will serve as input to the Steering Committee, the project office, and the module teams, keeping them focused on reality.

3. Responsibility for the design of the modules lies with design teams working in the field and selected on the basis of written prospectuses evaluated by the steering committee and project staff. The design team is to: select a topic within the matrix provided by the Steering Committee; develop the module in terms of their expertise, experience, and estimate of its success; pretest it in the local schools; and revise it on the basis of the initial feedback. The module is then submitted to the project office, where it becomes the responsibility of the staff. As indicated above, the final product will be the result of the joint efforts of the Steering Committee, the module-design team, and the project staff. The model for the design team is for it to consist of a behavioral scientist, two master high school teachers, and two high school students. It must be emphasized, however, that

variations are not only possible, but desirable. What is important is that each design team is constituted of those with competence in secondary school teaching, those with competence in the subject matter, and those who represent the student's perspective. Nor is it expected that the person who has the primary responsibility for the team--the team leader--will be the behavioral scientist. Indeed of the first few modules funded, two of them have a secondary school teacher as the team leader.

HISTORY:

1. In December 1967, APA sponsored an NSF-funded Pre-College Planning Session in Williamsburg, Virginia. Participants in that session, representing the disciplines of psychology, sociology, anthropology, and economics and the field of education, envisioned a secondary school behavioral science curriculum consisting of a unified first course followed by specialized courses in the separate disciplines. To that end the group proposed that it become the steering committee for a cross-disciplinary conference that would seek to conceptualize such a curriculum. At the same time, however, the group acknowledged the need for the separate disciplines to proceed independently in developing curriculum materials.

2. In December 1969 a group of prominent psychologists initiated a policy statement favoring pre-college curriculum development. The statement was subsequently adopted by the Education and Training Board, the Board of Directors, and the Council of Representatives of the APA.

3. The statement became the foundation both for a 5-week project at Oberlin College in 1970 (funded by the U.S. Office of Education) that produced the first edition of the aforementioned source book for high school teachers, and for a 14-month effort at the University of South Carolina in 1971-72 to develop two prototypic instructional modules (also funded by U.S.O.E.).

4. In 1972, the Board of Directors of the American Psychological Association, on the recommendation of the Committee on Pre-College Psychology and the Education and Training Board, voted to appoint a director of a proposed curriculum project whose first task would be the development of a proposal to be submitted to an appropriate funding agency. In August 1972, John K. Bare, Professor of Psychology at Carleton College, was named director of the project. On February 21, 1972, the proposal was submitted to the National Science Foundation, and after review and modification, the Human Behavior Curriculum Project for Secondary Schools was funded on January 1, 1974.

PERSONNEL

a. The Project Director is Dr. John K. Bare, Professor of psychology and former chairman of the department at Carleton College (Minnesota).

Dr. Bare has a longstanding interest in pre-college and undergraduate education in psychology. A past president of APA's Division on the Teaching of Psychology, he served as staff director for the 5-week Program on the Teaching of Psychology in the Secondary School at Oberlin College in summer 1970 and authored Psychology: Where to Begin, a booklet for the beginning teacher of psychology jointly published by APA and ERIC/ChESS.

b. The Associate Director for Evaluation is Mr. Robert S. McCargar. Mr. McCargar has undergraduate and graduate training in psychology, sociology, and social psychology, is extensively experienced in social-behavioral research on a broad range of community problems, including urban renewal, social work, and delinquency, has taught at the college level, and served as both an evaluator and a curriculum developer.

D. 14. b: HB (Panel 3): Project Director's Response to 10 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The need for the materials is reflected in several ways.

o No systematic attempt to introduce the subject of psychology into the high schools has been undertaken, yet the data available (Engle, 1951, Gertler and Barker, 1972, Statistical Abstract of the U. S., 1974-75) indicate that the growth in the number of high schools offering psychology is both remarkable and surprising. Four percent of the high schools in 1950 offered a course in psychology; 19% did so in 1971. In the four years between 1969 and 1973, the estimated number of high school teachers increased from 7,400 to 9,800 (NSTA figures), and in 1973 there were one-fifth as many teachers of psychology as there were in biology. In 1971-72, 64% of Colorado's high schools offered a course in psychology; in other states--Delaware--45% (1972-73), Florida-80% (1970-71), Georgia-35% (1972-73), and Montana-34% (1972-73) (Stahl, 1974). The growth, it should be noted, thus appears to stem from student interest and demand.

o In 1973 the number of states having separate provisions for certification in psychology was 30 of 51 (including the District of Columbia), and the remainder had no legal provision (7), provision under social studies (13), or provision under behavioral science (1) (Johnson, 1973). Thus in 2 of 5 states the teachers have not had a training program designed with the advice of leaders in the field.

o No materials are available that utilize the methods of instruction that teachers have found desirable (Nuthall and Snook, 1973). The available materials are usually in textbook form, with one to three authors (Kasschau and Wertheimer, 1974), they thus rely on teaching strategies that may put some students at a disadvantage, and they have not been produced with assistance of both high school teachers and students who can provide invaluable insights and suggestions.

o The most difficult task for all teachers is to keep one's knowledge current enough to teach a wide variety of topics. These materials will provide for the teacher the background necessary to teach them as well as resources that would otherwise not be available.

o There is widespread need for greater understanding of others as well as ourselves, and these materials lead the student in that direction.

o Appendix A contains excerpts from unsolicited correspondence to this office.

Implicit in the statement above is an answer to the first sub-question in this section. The project has not carried on an independent effort at assessing needs, however those may be defined; we are cognizant of research in this area.

The number of students that the materials might reach is hard to estimate. Fairly recent date (Stahl, 1974) suggest that 52% of the high school students enrolled in Colorado would take a course in psychology; 25,201 students in Florida were taking a course in 1970-71 (a four year estimate would be approximately 100,000, with 761,000 enrolled in secondary schools in that state in 1973); and in Oklahoma in 1972, 47% of the seniors, 39% of the juniors, 13% of the sophomores, and 1% of the freshmen were enrolled in a course in psychology.

No instructional material like those being developed is available. There are textbooks; there are materials on related topics produced in the Sociological Resources for the Social Studies (SRSS) but these are from a sociological point of view; there are materials at a lower grade level on some of the topics being produced by the Human Sciences Program; a few of the topics to be treated will be covered in the Individualized Science Instructional System, but overlap will be carefully avoided; there is Exploring Human Nature, but it is a year course, its approach can be described as involving a macro- compared to the micro-analysis of this project, and the emphasis is on the ways in which societies shape the individual rathe than on the variables responsible for individual behavior and the way that individuals interact, to which the materials of this project will speak.

Question 2: Is there a market for these instructional materials?

The question and the sub-questions essentially ask whether there is a market for these materials in terms of: competition from available materials, the availability of space in the curriculum, the project's dissemination plans, the need for funds for implementation, the past response of free enterprise, and the likelihood of use. Each of these variables will be treated separately.

Available materials. There are for the high school nine textbooks, three laboratory manuals, and no books of readings. None of these, as indicated above, use the teaching strategies which high school teachers have found to be desirable. Far more importantly, none of the presently available materials have articulated the teaching strategies with the content, and none make use of one of the unique characteristics of psychology--the possibility of using the content to teach the content. The principles of learning may be used to teach learning, experiencing a perception may be used to teach about the perception, and so on.

The availability of space in the curriculum. The data cited above indicate that instruction in psychology and human behavior is already a fact, and the amount of instruction is increasing. The materials in this project are designed not only to fit semester or year-long courses, but to be used for as little as two to three weeks in other courses to extend them into the domain of human behavior, e.g., courses in biology and human development. A module on the topic of human learning (How We Remember What We Need to Know) might well speak to the learning in which all high school students are involved.

The dissemination plan. Dissemination is used here to mean the broadcasting of information about the project and its materials to those responsible for making decisions about adoptions, and simultaneously providing widespread information about the project to others. Preliminary information has already been presented in person to the Curriculum Committee of the National Council of Social Studies and at two annual meetings of the American Psychological Association, and such efforts will be extended to the Association of Supervisors and Curriculum Developers, the National Science Teachers Association, the American Education Research Association, as well as the regional associations of these organizations where they exist. The project's Advisory Committee members provide us with resource persons, as do module team members, in the Committee on Pre-College Psychology of APA, pre-college liaisons with the Educational Affairs Office of APA, the local and national trial teachers, and members of the American Psychological Association. Most importantly the American Psychological Association, through its clearinghouse for pre-college psychology publishes a free newsletter, Periodically, nine times a year, and our newsletter accompanies it four times a year. There are, of course, several journals: The History Teacher, Teaching of Psychology, Social Education (the last two are both willing to carry articles on our efforts, we have been told).

The reliance on NSF implementation monies. If implementation is conceived of as including preliminary trials, the training of resource personnel, and the orientation of schools and key teachers, then NSF monies will be required for the preliminary trials, but it would seem to be possible to rely less on NSF for training of resource personnel and perhaps in orienting schools and key teachers. The latter results from the facts that 1) previous curriculum projects have provided some instruction in the teaching strategies to be employed, and 2) the materials are designed to provide as much as possible in terms of the needs of the teacher as the module is used.

The past response of free enterprise. As indicated above, the response in the past of the free market has been to produce textbooks and laboratory manuals, often patterned after introductory college texts, and the latter leave much to be desired. Moreover, it is an erroneous assumption that the high school course should be a simpler version of the college course.

The likelihood of use. In addition to pointing again to the comments of teachers and others, one can cite publisher interest. The announcement to all publishers will be made in early January and a meeting will be scheduled at the ASCD meetings in the spring. Even in the absence of that announcement, expressions of interest have been received from Science Research Associates, Canfield Press, McGraw-Hill, Little Brown and Company, Xerox, Holt, Rinehart and Winston, Ernst Klett Verlag in Stuttgart, Germany, John Wiley, Addison-Wesley, Prentice-Hall, Houghton-Mifflin, McDougall Littell and Company, Harper and Row, Scott-Foresman, and Steck-Vaughn.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The rationale for this curriculum effort has been clear and consistent from the beginning, for it is described in the same way in the proposal and the Module Design Handbook, albeit the last in terms of the learner, the learning process and the nature of the discipline. The handbook is quoted here.

Nature of the learner. The students, like everyone else, desire to understand their own behavior and that of those around them; to put it in an imaginary student's words "to understand myself better and to find where I fit in society." Students further want, it appears, to learn those things that will serve them in their everyday experiences both at work and play.

Interestingly enough, one who has not studied behavior systematically is often well-schooled in experience but psychologically naive; one has been in constant contact with self, but the behavior of others is interpreted on the basis of one's own experience, which provides at a minimum an idiosyncratic view of the world. One's own behavior may also not be understood, and it therefore becomes all too easy to imagine that the causes of behavior are usually mysterious, hidden beneath the skin, in one's unconscious, in instincts, and in the distant past. Behavior appears more fixed than malleable, more dependent upon will than any other variable, and one's own behavior is taken as the standard.

Nature of the learning process. Learning must of course build upon the previous learning and the interests of the students, but it must take the student beyond the present in both knowledge and interests. It occurs in a variety of ways, i.e., by reading, by listening, from demonstrations, from active participation, in discussion, and in reflection.

Nature of the discipline. In psychology's relatively short history, psychologists have become convinced that human behavior can be systematically observed, that it exhibits enough regularity to make

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possible the derivation of general statements, and that principles of human behavior, often quite different from those based on the opinion generated by private experience, can be discovered by empirical means. To recognize that the same principles make possible an understanding of the behavior of others as well as one's own is to emphasize the similarities that all of us share; to understand how the variables in the principles differ for each of us and what the variables are that are most important to those differences is clearly central to putting self into society. The result of such understanding might well be greater respect and compassion for another and an equalitarian view of all.

The study of human behavior appears to enjoy other unique characteristics. For one thing, the question of whether the subject matter is "relevant" appears to be inappropriate. The more appropriate question might be whether anything in the content area is irrelevant to the understanding of human behavior.

Most importantly, an understanding of human behavior can speak to the values that each of us holds. If one can see clearly the consequences of any behavior for all, that knowledge must be critical information in the making of the value decisions which all of us face.

If the analysis of the nature of the learner above is correct, then one can expect that materials developed in this project will fill the needs of the learner.

Every effort will be made to insure that the individaul modules will reflect these assumptions, goals and values championed here, and those materials that accompany this report do so, we believe. Materials might, of course, be generated by another set of goals and values, but the assumptions about the needs and the nature of the learner reflect reality in the opinion of the project staff, or very nearly do so. The goals chosen here and the values which they reflect are of key importance to the materials and provide a continuing source of motivation for the difficult tasks involved in curriculum development.

To turn to the clarity and cohesiveness of the materials, for the purposes of this answer it is assumed that cohesiveness refers to a package of several modules and that clarity refers to each and all modules. Because the materials available are not in final form, the process for achieving clarity and cohesiveness is described. Clarity can be assured by adequate review by the project staff, the Steering Committee, the Advisory Committee, from the results of the local and national trial, and by the inclusion of high school teachers and students on the development teams. To assure cohesiveness the project staff will prepare for teachers a handbook suggesting the selection and organization of various modules into a longer course with several alternatives, and the teacher handbook for each module will identify possible interfaces with other modules. For each possible set of modules there will

be provided something seldom found in an elementary text--a statement of the rationale for putting the materials together.

Question E can refer to the selection of topics from the large number in the discipline or the selection of proposals for inclusion as modules regardless of the topic. The selection of the topics and their ordering in terms of priority were accomplished by the Steering Committee on the basis of three criteria: the certainty of the knowledge in the area, the interest of the material for the student, and the appropriateness of the materials for use by the high school students.

The selection of a particular proposal for inclusion in these materials is based on the following criteria:

Rationale. What aspects of behavioral science are appealed to as justification for developing the unit? Are there concepts that will aid the students' understanding; are there principles that are well-grounded in data; are there basic processes that the student should be familiar with; does the unit provide a perspective that is helpful in viewing human behavior; does the unit lend itself particularly well to the demonstration that behavior can be systematically studied; and/or does it demythicize widespread erroneous notions of the causes of behavior?

If the topic has not been included in the list by the Steering Committee, is a convincing case made for the inclusion of this topic instead of one on the list? Are there needs among the students, important objectives, or circumstances that emphasize the desirability of a unit on this topic?

Objectives and goals. Does the proposal contain a set of well-formulated objectives for the unit? Are the objectives realistic for the students for whom they are designed? Are the central problems for achieving the objectives identified and discussed? Are the objectives then integrated into the body of the proposal?

Are the broader goals of the unit included with at least some elaboration? Do the objectives lead to the achievement of the goals?

Means to the goals. Are the means of accomplishing the objectives spelled out? What is the rationale or evidence that supports the conclusion that the means will indeed accomplish the ends? What assumptions underlie the selection of the means? Are those assumptions sound?

Pedagogical strategy. Is there an overall strategy for the design of instruction? Are daily instructional techniques appropriate to the strategy? So far as possible, is the knowledge used to teach

the knowledge, e.g., programming to teach operant learning, role playing to teach about roles, and so on?

Does the material appear to be potentially intriguing to the high school student?

Is the student led by the materials to see additional problems that he or she might pursue if he or she has the ability, time and/or motivation?

Question 4: Is the content of the materials scientifically correct?

This section asks whether the materials are scientifically accurate and current, whether the materials train future scientists or are designed to produce a scientifically literate populace, and what portion of the discipline is represented by the materials.

To assure the accuracy of the materials, several facets of the development process were intentionally included. Each design team must have a subject matter specialist, each proposal is reviewed by at least two members of the Steering Committee composed of 15 distinguished behavioral scientists, each proposal is carefully reviewed by the project staff, and where it seems advisable, consultant specialists may and have been asked to review the proposals. When the manuscripts for the module are received, the project staff and members of the Steering Committee again review the manuscripts for accuracy. Included on the project staff are two senior members who have each had approximately thirty years experience in the behavioral sciences, one in the experimental and physiological side and the other in social and applied areas. A third content specialist is scheduled to join the staff on January 1, 1976.

The same review process assures that the materials are current and solidly grounded in data. The latter phrase has been added because there is some faddism in science. There may be more than usual in psychology. Moreover, most scientists have learned to cultivate and cherish doubt. Elsewhere the project materials indicate that the principles to be included are those that have some chance of existing for some time to come.

What group do we seek to train, future scientists or a scientifically literate populace? "Both", we would loudly proclaim. But in order to achieve the broadest impact we teach for scientific literacy, confident that future scientists profit most from such training at the elementary level. The target audience of students will do and use behavioral science, so that they can apply the ideas, perspectives, and experience to everyday life.

Finally, there is the question of the portion of and the approach to the discipline represented by the materials. The topics for the

modules are broadly representative of the problems and findings in behavioral science with its focus in psychology. Individually, the modules will not survey a particular topic but will be limited to a selected number of problems and findings within the topic that are vivid and interesting to the students and will engage them in search and understanding. No particular viewpoint is represented in the materials. The topics range from the biological bases of behavior to social interaction, and to reflect contemporary psychology adequately, the approach is, as it must be, eclectic.

Question 5: Is the content of these instructional materials educationally sound?

Adverse or especially favorable reactions from teachers, staff, parents, or pupils. The reactions of interest here may be directed toward either the teaching strategies or the content. So far as teaching strategies are concerned, as HBCP Occasional Paper #1 entitled Models and Modules indicates, a variety of teaching strategies will be employed. As indicated above, the strategies are those with which teachers (and their students) have become familiar. At least for inquiry teaching, a study by Coan in 1961 suggested that parents were generally agreeable even then to the use of the inquiry strategy (Coan, 1961).

Because the topics for the modules both include and go beyond those commonly offered in the high school (Engle, 1967; Ryan, 1974) positive reactions to the content are anticipated. Indeed, the correspondence received in this office suggests enthusiastic approval. However, there are three topic areas which have some potential for adverse comment if not treated wisely. These are Family Counseling, Conditioning and Behavior Modification, and for some, Natural Behaviors in Animals and Man. The project staff is quite aware of the difficulties that may lie ahead for these topics and intends to include them only after it has been assured on the basis of the best advice available, including that from the very knowledgeable Advisory Committee, that the treatment of these topics is such that the probability of an adverse reaction is virtually zero. We believe that instruction on these topics in the high school is important; and many parents agree. But the importance of teaching the topic of human behavior is so clear that we will not let the effort be hoisted on the petard of those who do not differentiate against studying about various problems and the advocacy of a particular point of view. To come at expectations from a positive direction, a number of the topics seem highly desirable as a part of the understanding of all of us, and one might therefore anticipate favorable reactions from all.

Special problems or special promise in the content and/or the approach. From what is known about the late adolescent (e.g., Elkind, 1970), the materials would appear not to present any special problems. Quite to

the contrary; the materials appear to be able to complement and perhaps extend the developmental process. In students of this age, as Elkind notes, formal operational thought is present and no new mental systems develop. Moreover, the students are differentiating between their own preoccupations and the thoughts of others, and the feelings of others are being integrated with their own emotions. Indeed, if an understanding of self and others is to be a part of the curriculum, it would appear that this would be an ideal time to introduce these particular instructional materials.

So far as the possibility of fitting instructional strategies to learning styles is concerned, if that appeared to be possible it would certainly be part of the instructional strategy of the project. The data available on this issue are not reassuring; the early suggestions of the compatability of particular learning styles with particular teaching strategies have been very difficult to confirm (Anderson, 1970). It thus becomes very difficult to identify whether there are high school students for whom the materials are ill-advised or potentially particularly effective.

Strategies for value-laden areas. It would seem to be impossible to escape value questions in either psychological research or psychological instruction. Nor is it in any way desirable to do so. Wherever appropriate, in these materials value problems will be confronted. Because we seek to help students examine and analyze their values, one consequence might be a rational ordered set of values that dictate certain behaviors. The subject matter of psychology seems particularly appropriate for such purposes, for values must ultimately be dependent upon the consequences of one's behavior for all others. To put it another way, one of the consequences of the study of psychology is to come to the conclusion that our enjoyments and sufferings arise from common causes, and that what we value is common to us both and dependent primarily on the behavior of each of us toward the other. No claim for originality in dealing with values is made here, except for the leverage that our subject matter provides us, which would appear to be considerable.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

We have spoken to intended outcomes by describing our purposes and goals in response to question 3 above. Our hopes are to realize all of the intended outcomes; we may fail, but we must try. The major impact might be expected to be on students and teachers, and the former, from our perspective, are far more important. The materials are designed to say two things to the student: if you

learn these materials you will be able to apply them in your everyday life; if you come to understand the process by which problems of human behavior are posed and solved, you ~~will~~ gain a perspective that will increase knowledge from your life, and result in experiences that will serve you far beyond the specific content of this course.

Every effort will be made to keep the materials free of sex, racial, ethnic, and religious bias or stereotyping. Not only is the Procedures for Module Development Teams very clear on these issues (the booklet is distributed to all teams); but the composition of the Advisory Committee provides another very important dimension to the way in which we can deal with potential problems in this area. On that Advisory Committee of eleven there are five women, one of whom is a Native American and a second who is Chicano, and six men, of whom two are Black. A fair description of that committee is that they are very perceptive on this issue, and quite vocal. Recall that members of the Advisory Committee review the materials at the local trial stage, and if need be, at the national trial stage.

There are indeed very important process features which should be emphasized. Psychology is unique among the sciences in that it is at once both objective and subjective. While the subjective features are now just beginning to yield to the methods of science (in the area of cognitive psychology, for example), one's subjective experience of psychological phenomena adds to the understandin of the objective principles discovered by the usual scientific approach. One has both knowledge of and knowledge about psychological phenomena, and the combination provides a richness not easily obtained in other areas. In addition, instruction in psychology presents the opportunity to use the material to teach the material: programmed learning can be used to teach the principles on which programmed learning is based, participation in small groups can be used in part to teach about the dynamics of such groups, perceptions can be used to t [illegible] bout the principles of perception.

There is one very important feature of our process for the development of the materials in this project, and that is the inclusion of high school teachers and students on the development teams. That feature has several important advantages: it provides, during the development of the material, immediate input on contemporary teaching strategies of which the psychologist-author may not be aware; it provides continuous monitoring of the materials in terms of their potential interest to the high school student of which the psychologist may not be aware; it avoids the problems that can result from having a text be perceived as the latest word from above; and perhaps most importantly, it provides for mutual instruction--the high school teacher by the psychologist and the psychologist by the high school teacher. Both, in our view, have much to learn from one another.

Questions 7 and 8 deal with implementation and in part assume that the project has been given the authority and resources to provide for a detailed implementation plan. This has not been so in our case. Our proposal included the staff position of Associate Director for Implementation, whose primary responsibility was to be that of developing and carrying out an implementation plan. We had conducted a four month search for this person, had narrowed the applicants to three, and were about to hire, when all implementation efforts by NSF were stopped pending a new definition of policy by NSF. To date this policy has apparently not been settled upon. In view of the lack of guidelines, authority and funds for staff, we have suspended planning in this area.

A primary reason for selecting a module rather than a text format is to provide a highly flexible set of curriculum resources. This flexibility helps minimize implementation problems. Schools or teachers may adopt any set of topics they choose. The ease of implementation is further increased by a well-developed teacher guide, which is designed to provide the teacher with:

- a clear statement of central objectives and methods
- a useful description of the suggested teaching strategy
- a general background discussion which places the topic in the broader context of the social sciences, and presents a rationale for its use in the high school curriculum
- a specific background section for each subtopic or daily lesson, stressing concepts, principles and procedures
- specific lesson plans, discussion questions and related assistance
- suggestions for connecting and providing transition between parts
- suggestions for linking the module with other topics

Question 7: <u>Do these instructional materials present implementation problems for schools?</u>

<u>Special training</u>. Our objective is to make each module sufficiently self-contained that a teacher without a specific college background in the behavioral sciences could teach the module without outside assistance. However, various implementation efforts, including specialized training, would encourage and facilitate use, and improve the quality of use. This applies with particular force to this content area, because many teachers do not have a strong background in behavioral science (Gnagey, 1971).

We assume, however, that specialized training need not be restricted to our materials but could include any and all materials on relevant topics.

Special problems. The materials are designed for use in systems employing conventional scheduling and pose no unusual problems for them. Schools employing modular scheduling, alternative schools, or other less conventional arrangements may wish to adapt the materials to their special structure. However, modular units of the kind being prepared are flexible enough to make adaptation possible.

Costs. No specific cost figure can yet be computed for these materials. The target cost to each user is $25-50 exclusive of the cost of student booklets. Materials using a very similar format cost between $.83 and $1.04 per student booklet when bought in groups of ten (teacher's guide included free). At this price modules could compete effectively with textbook-based material, or could be used to supplement texts without excessive additional cost.

Special resources. The materials require no special learning resources beyond conventional equipment found in most high schools.

Need for optional classes. While the social and behavioral sciences are sometimes thought to be highly vulnerable to parental opposition, sensitivity would seem to be limited to a relatively small number of topic areas specifically included in these materials.

We have no modules or parts of modules which deal directly and specifically with religion or religious behavior, attitudes and values, and we see very few module areas which treat scientific issues upon which there is likely to be opposition on doctrinal grounds.

Question 8: Are the costs of implementing these instructional materials reasonable?

While we do not have a specific implementation plan from which expected cost may be extracted or estimated, we do not anticipate the need for large expenditures either by the project or by school systems for implementation.

Insofar as the project is concerned, funds are needed to accomplish the following:

1. To inform the community of educational consumers concerning the availability, nature and merits of the materials. This includes primarily making formal presentations and/or exhibiting materials at appropriate regional and national conventions (APA, NST, ASCD, NCSS). It could include funds for appearances at institutes, conducted at various colleges and universities where these are not covered by institute funds.

2. To conduct how-to-do-it institutes in organizing these modules into a longer course--nine weeks, a semester, a year. These institutes would deal with the several kinds of courses and approaches that can be used, and how to select, order and connect the modules to achieve course objectives.

3. To expand and provide greater depth of information for the existing network of influential persons in the educational community who can facilitate use of the materials. Presently we have a small network of key persons who are aware of our materials. By systematically expanding this network, and by providing them with more assistance and incentive, we believe they can be of great assistance in facilitating the adoption and use of our materials.

These implementation steps do not eliminate the need to provide teachers with a better substantive background in the behavioral sciences and to improve the ability of teachers to use teaching strategies which are suitable for specific content objectives.

Continuing costs. There are no continuing costs of using these materials.

Alternatives in the expenditure of funds. School districts might construct their own short units, and have indeed done so. We doubt, however, that they can achieve the scientific merit of these materials.

Costs of comparable materials: To our knowledge there are no materials completely comparable to those being produced here. While text prices vary, the average text cost of seven high school texts is $9.75. The average cost of three accompanying workbooks is $3.57.

Non-fiscal costs. New, innovative materials require that people change their ways of thinking and behaving, and that they exert and direct their energies in new ways. This cost will be balanced by the satisfaction by the teachers in using these materials, and by the psychological and social gains experienced by the students.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The grantee is the American Psychological Association, an organization of 39,411 members, to which most qualified psychologists belong. Direct oversight is provided by the Steering Committee, an ad hoc committee of the Board of Directors of APA and appointed by them. Liaison between the APA and the project is through the Educational Affairs Office, which also publishes the newsletter for pre-college psychology and the project newsletter. The Administrative Officer of Educational Affairs is an ex officio member of the Steering Committee. Advice and guidance are provided by the Advisory

Committee, described above, and by the Committee on Pre-College Psychology of APA, of which the Project Director is an ex officio member.

The eventual table of project organization includes six professionals (Executive Director, Associate Director for Evaluation, Associate Director for Development, two Development Associates, and an Editor-Writer), an Administrative Assistant and an Office Assistant. Two of these positions have not yet been filled. The position of Associate Director for Development has just been authorized, in lieu of suspended authorization for an Associate Director for Implementation. The second Development Associate position is authorized for January 1976. The project staff are temporary employees of the American Psychological Association.

The project office is located at Carleton College for several reasons. These include: (a) there are the resources of two colleges in the same town, (b) the University of Minnesota is a short distance away, and (c) independence from other curricular efforts can be assured and seemed desirable.

Opportunities for input. The project follows a decentralized field model of development in which teams are the basic developing unit. The team approach maximizes and integrates the interests and contribution from three sources: subject matter specialists, teachers, and students. Monitoring team activity is accomplished by site visits, telephone, and mail.

To qualify as a team, a proposal must be submitted, setting forth the essential features of the proposed module. This is reviewed by the staff with clarification and amplification typically requested prior to a review by the Steering Committee. Successful projects receive a handbook of administrative procedures and the development process is begun.

External evaluation procedures. The trial process along with the development procedure give an opportunity for interested parties, particularly educators and students, to provide input to development. (See Local Trial Procedures and Policies Governing Trials of Materials.) An Advisory Committee of 11 educators also provides input prior to the trials.

The above external evaluation is of a formative nature. Independent summative input of completed products has not been solicited, because it is highly unlikely that the project will be in existence to make use of the results.

Internal monitoring procedures. Because we have carefully spelled out in writing what the procedures are, internal monitoring is relatively easy. We point with pride to the fullness of our descriptions of the process.

Adequacy of information. We have made every effort to furnish NSF with information needed to monitor the grant, as well as our Steering and Advisory Committees, and the relevant committees and officials of APA.

10. Additional Comments.

We must, we feel, comment on the delays we have experienced with the National Science Foundation. On March 13, 1975, we were prepared to have an additional team in the field begin their development effort, and on June 12, 1975, we were agreed that a second team could begin their efforts. The support of these teams involved agreements with organizations rather than individuals. We asked NSF for permission to make such agreements as directed by the NSF Grant Administration Manual (NSF 73-26, October 1973). To date (November 21, 1975) the decisions required have not been received from NSF. In addition, on July 16, 1975, we were told to make no further agreements with teams until this issue and related ones were resolved, and to date that ban has not been lifted in spite of considerable efforts on our part. What must be emphasized here is that the making of agreements with teams had been clearly spelled out in the original and second proposals which we submitted, dated February 21, 1973, and August 28, 1974, respectively. We recognize the considerable burden placed upon the National Science Foundation by Congress, but we cannot resist pointing out that we have been delayed in our efforts for a considerable period of time by events over which we have had no control.

At the receipt of Dr. Averch's first letter, dated October 23, 1975, we wrote a paper for him entitled "The Human Behavior Curriculum Project: The Need, the Goals, the Procedures, and the Strengths and Weaknesses. A Self Evaluation." It was not as extensive as this, but does contain material that is not included here.

We can only add this final note:

The task of preparing this material, while a disruption to our preferred activity, has been useful to the entire staff for it has given us an opportunity to reflect again upon the mission we have undertaken, the project plan we have designed to accomplish, the actual concrete steps taken, and their outcomes. While we are aware of some of our own shortcomings, we also have an unshakeable confidence in the essential soundness and worth of what we have done and are doing. We shall look forward to making positive use of your contributions. A commitment to considerations of due process leads us to hope that you will provide us with an opportunity to respond to the findings of the review panel, whatever they are.

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D. 14. c: HB (Panel 3): Panel Responses to 9 Review Questions

NSF Staff Note: Panel 3 completed a first draft of the review of this project by December 12 and selected a 5-member "editing committee" from the panel to work on a final draft. A typed copy of this first draft was circulated to all panel members in January for their comments and reactions. The "editing committee" met with the Panel Facilitator on January 24, 1976, reviewed the first draft, the comments of other panel members and prepared a final draft of the review for mail circulation to the entire Panel. One panelist submitted additional written comments on the final version included at the end of this section.

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Question 1: Is there a genuine need for these instructional materials?

The project staff has seriously addressed the question of needs. The results of this effort have been included in the original project proposal and in supplementary statements.

The following general needs have been discussed in the project materials: the quality of instructional materials for use with high school students reflecting currently acceptable professional standards; the preparation of teachers in both the substance and methodology of psychology; and the rapid increase in the number of schools, students, and teachers interested in high school psychology.

These needs have been well documented by the project staff. However, while the assessment appears to support a need for the development of high school psychology materials, it does not document a need for these particular modules.

Question 2: Is there a market for these instructional materials?

The program developer provides a listing of the other products available in this field but states that these materials do not meet the needs of secondary schools. The panel relied on the developer's data concerning need since adequate information was not available for an independent assessment.

There is room in the existing curriculum for this program but it is advised that it be offered as an elective. This program provides opportunity for team-teaching and also for a selection of individual topics/modules that can be incorporated in a single course or used as a portion of an existing course.

The American Psychological Association has begun planning dissemination procedures through cooperation with other professional organizations. However, as the materials are still incomplete, the free market response cannot be estimated. NSF funds might be needed for teacher-training and further development of teacher manuals.

Question 3: Do these instructional materials possess a clear purpose and rationale?

It is assumed that systematic study of behavior can increase the student's understanding of the lives that each of us leads. The instructional materials emphasize and imply principles of behavior and the data on which they are based, namely those principles exemplified by human interactions and interactions between the individual and the environment.

The materials are not in final form, but would be more acceptable if the developers would pay particular attention to increasing non-print space, diagrams and pictures. In addition, students should participate more actively in constructing materials and devising experiments. The developers acknowledge that there is overlap with other existing curricula; therefore some integration and separation should be considered.

There is no basis for judging the rationale for the selection of specific themes because the materials are incomplete. These materials have been designed to help meet the needs of high school students in coping with their social situations. In some instances, e.g., in "Personality," the material may be too difficult. In others, e.g., "Family Counseling," the inclusion of extensive material on sexual behavior may create problems in terms of community response.

Question 4: <u>Is the content of these instructional materials scientifically correct?</u>

In general the answer is yes.

The project utilizes sophisticated theory and research results. However, the developers seem to be writing as much to their colleagues as to students. The content of the material is current, but it burdens students with excessive citations.

The project aims at helping students to become scientifically literate rather than to become psychologists. However, the developers assume high reading ability and familiarity with psychological terminology.

The developers appear to be so anxious to be scientifically correct that the modules have become far too long. The materials now in draft and available to this committee are already too lengthy for a one year curriculum; yet, they represent only one fourth to a third of the proposed content.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

Recognizing that the project is in the early stages of development, the panel generally believes that the materials are educationally sound. They were divided over the issue of whether or not instructional materials should have clinical objectives.

In the panel's judgment, there may be adverse reactions to some modules. The developer specifically mentions one, "Family Counseling," as a possible source of controversy. We agree that there is a high probability of negative reaction because of the sexual content. This module would probably have to satisfy the sex education consent requirements in many jurisdictions. The use of certain teaching methods may create controversy. For example, the module entitled "The Family" would not necessarily be controversial.

However, if there is a discussion on family conflict which uses personalized role-playing as one of the teaching methods, this could lead to controversy.

To the developers' credit, the material abounds with cautionary notes to teachers concerning possible personalization of material by students. However, the topics planned and the methods used may well make these cautions difficult to heed. In our opinion, relatively few students will be able to master the desired content due to the volume and complexity of the material and the difficulty of the readings. The panel does feel that there will be favorable reactions to the availability of short modules (2 week average) which provide flexibility for staff and students.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The developers anticipate that these materials will improve the quality of instruction in human behavior at the secondary level. The panel believes this to be a worthy objective. Yet for the materials to have this intended effect, they must be organized and expressed in a manner more easily understandable to high school students. If this is not done, only a few students may get the full benefit from them.

The developers avail themselves of many procedures: didactic, experimental, simulations, written essays, and analytical exercises. We approve of this multiplicity, especially the written essays which are rarely used in contemporary curriculum projects. Some undesirable consequences may occur because of inadequate teacher training. For example, certain activities could be emotionally upsetting to some students if not handled with great sensitivity and tact. Still other activities seem highly questionable. Two cases in point are: having a student play the role of a person suffering from brain damage and requiring students to keep a sexual experience diary.

Question 7: Do these instructional materials present implementation problems for the schools?

Special teacher training and preparation seems imperative because of the complexity of the content, its value-laden nature, and the need for teacher sensitivity. Without such training, some of the content and teaching methods could be a source of serious controversy. Also, without the benefit of such training, teachers may avoid using some or all of the materials and therefore the value, to schools, of a potentially worthwhile course would be lessened or lost.

According to the developer's cost projections, these modules would seem to be competitive with other published materials. However, the cost of teacher training will add considerably to the cost of implementing the program.

Question 8: Are the costs for implementing these instructional materials reasonable?

As an alternative to adopting this program, a community might meet these same needs through workshops, minicourses, or electives dealing with specific sub-topics such as: family-planning, human sexuality, understanding oneself, and human behavior.

Programs such as these could be conducted by outside specialists such as clinical psychologists, marriage counselors, and school nurses. The panel lacks sufficient information to judge whether or not this alternative would be less costly than the adoption of this program. It seems imperative that schools should be provided the opportunity to select modules that seem appropriate for meeting their particular needs rather than being forced to purchase the entire package.

Question 9: Is the management/organization plan adequate for providing these instructional materials?

Judgments about management of this project are hampered because the modules are still in the developmental stage. The original proposal and the project's position paper were available indicating that many more modules would be forthcoming.

The project is notable for its wide inclusion of many scholars on the various development teams. Similarly, teachers and students are included on each team. There is no evidence that the views of parents have been solicited.

The American Psychological Association has appointed a fifteen-member policy board to establish the project's policy and to monitor the development. This board selected the topics for the various modules and chose the director and staff. There could be some serious problems in monitoring the modules because their development is "farmed out" to teams around the country, rather than being produced at a single center. The project director clearly has a formidable task in exercising quality control over packages produced under this procedure. His problem is not that of maintaining scholarly quality but of limiting length and infusing each module with sound pedagogical strategies.

All of the planned evaluation seems to be internal to the project. In the judgment of the panel, it would be advisable to have a careful and periodic external evaluation of it. NSF should also continuously monitor this project.

Additional Comment by Mrs. Kristine M. McGough

I am in receipt of the edited draft for Comparing Political Experiences and Human Behavior. Although I am in general agreement with many points of the final drafts, I feel too much of the sense of the panel has been lost in attempting to handle this by mail - I feel the entire panel should be reassembled so that we may have an opportunity to discuss it and take a vote as we did on Exploring Human Nature.

In regard to Comparing Political Experiences, I firmly believe that if this project was federally funded to replace traditional government courses - which appears to be the developer's intent - the burden should be on the developer, not the teacher, to insert material dealing with the Constitutional system of the United States.

The Human Behavior draft has suffered the most by the long distance review. The line "Ethical consideration is critical and should be closely adhered to if the goals are to be achieved" is vital to this report and was, to the best of my knowledge, agreed upon by the full panel - I cannot subscribe to the suggestion that it become some sort of "minority footnote."

What has happened to Dr. Tobach's report of 12/11?* Dr. Tobach's impressive professional credentials make her input particularly pertinent to Exploring Human Nature and Human Behavior. Her 5 page statement does not seem to be reflected adequately in the final draft. Dr. Tobach made strong recommendations concerning the development and teaching of all courses in the behavioral sciences.

I am personally uncomfortable with the reports on Comparing Political Experiences and Human Behavior. Given the time pressure and lack of material, I feel the panel report of Exploring Human Nature was a fairly good representation of the panel's feeling - I am not as certain that the other reports are.

I feel our responsibility as a panel is a serious one and a final report done without sufficient time for give and take and mutual learning does not seem to really fulfill it.

*NSF Staff Note: The final, typed response from Dr. Tobach had not been received when this letter was written. The response is now included in Dr. Tobach's statement on Question 10 (on EHN and HB) and here statement on Exploring Human Nature.

D.14. d:HB (Panel 3): Individual Panelist Response to 10th Review

Question: What are your general impressions of the curriculum?

Panelist: Dr. Douglas Alder

I read only the units on sleep and consciousness, communication and peer pressure. The latter was unnecessarily long. Endless cases, examples and activities were employed to teach the same concept. Perhaps the writers generated these to give the editor the chance to choose from among them.

I found all three units fascinating. They also did not seem to have adoption obstacles because of community norms. The proposal said that the APA intends to refine the modules to the point that they will not run afoul of community values and generate opposition. In these three units I think they are approaching their goal. My colleagues on the team however had very different feelings about some of the other units and I tend to support them. I have had some considerable experience with the national controversy on sensitivity training. Though I am in general an advocate of it, I must admit that even though some of the criticism has been irrational other criticism has opened up valid issues that the professionals were not handling well. I think the criticisms of this curriculum will hit some of the same points. Privacy of an individual's feelings can be invaded unduly in this curriculum. Teachers can become involved in dealing with counseling-like problems without professional competency. Students can be encouraged to reveal things that they may not wish to reveal. Community values can be unnecessarily offended. One example: in an exercise about peer pressure the students are asked who they would turn to for advice under many specific cases. Two of them include: who would you talk to if you became pregnant and who would you talk to if the girl you were sleeping with became pregnant. The assumption that the student may be sleeping with someone is dynamite. The question is posed in such a manner that the assumption is that those involved are not married. There are still a few people around who don't think that is the norm. Such issues are pretty sensitive.

In general I am fascinated with the administrative approach that this project is using, employing a professional organization. I wish them the best.

Panelist: Dr. Robert Angell

This project is in its early stages and therefore cannot be evaluated adequately at this time. The start is promising. The APA is selecting capable scientists to work on the design teams, though they must be sure to get adequate input from the high school teachers on the teams. One weakness already obvious is that the modules are being written at too difficult a level for most high school students. I have confidence in the administrative group directing this project and the oversight

that APA will give it. I therefore expect that they will carry out their responsibilities effectively and a good product will result.

Panelist: Mrs. Alethea Campbell

No comments submitted.

Panelist: Dr. George W. Carey

1. While the project proposers claim a need for this particular approach, they have certainly not documented the need. In fact, they do acknowledge that several texts are already being used and that the texts represent less sophisticated versions of the materials and approaches used at the college level. This means the claims made on behalf of their particular approach are in need of greater documentation than they provide.

2. While we lacked complete information concerning the three projects under review, we had relatively little information concerning the Human Behavior program--so much so that I question whether the panel can form valid judgments.

3. As our panel noted throughout its report, there is a high probability of adverse reaction to both the approach and some of the modules (e.g., the clinical approach and the family module).

4. Because of the complexity of the program, the need for teacher training in the proper use of the materials, implementation at the secondary level will be quite costly and cumbersome. I refer here, in particular, to panel judgment on question #7.

5. In my judgment, there are alternate ways by which the school systems, if they so desired, might meet the objectives of this program at far less cost. This could be done (see panel response to question #8) with existing resources at the community level.

Additional General Comments:

I should like the following remarks included in the official report. They pertain to Panel 3 and the social science projects funded by NSF.

(A) Our initial group decision regarding procedure was a logical one given the circumstances: namely, five days to examine with thoroughness three major projects in the social science area, having to draft responses to nine general questions in smaller subcommittees. Even though our procedures were reasonable ones, we did not have the time to complete our tasks. Our discussions in both the smaller committees and the group never were able to turn themselves very far from the questions that were put to us by NSF. The ten questions, in turn, overlapped and in many cases were redundant.

(B) Not all materials were available to us. In some cases, materials were available only in limited quantity which causes problems. This was true in varying degrees with all three projects under review, most so with respect to Exploring Human Nature (EHN) and Human Behavior (HB). In my judgment, this was a very serious shortcoming with respect to EHN, certainly the most controversial of these projects.

(C) With respect to the programs under review, one of the major questions that arose continually concerned need; that is, whether a need existed at the secondary level for courses built along the lines set forth in these programs. In this respect the following should be noted:

1) We were more or less forced to take the word of the project initiators relative to need. There was no way for us to determine need.

What is clear, however, is that need, as set forth in the proposals, was in large part confused with the presumed novelty of the approach. More exactly, in all proposals much was made of the fact that the existing high school social science curricula did not utilize the approaches outlined in the proposals.

While this is undoubtedly true in all cases, such a state of affairs simply does not constitute evidence of need. There are countless approaches to the study of man which are not utilized at the secondary level but from this it does not follow that the secondary curricula are deficient and in need of revamping.

2) Where need was shown in justification of one program through citation to surveys which reveal an alarming ignorance on the part of large percentages of the population concerning our basic constitutional system, the project itself was not directed to the alleviation of the deficiency. Quite the contrary. The CPE program expressly states that its chief value is its lack of emphasis on the formal institutions and processes of our government. In this sense, the whole project is an anomaly. Part of its justification rests on the political ignorance of the American people with respect to formal institutions, yet its thrust in no way would serve to rectify this condition. It would, in fact, make the situation worse if its program were implemented at the secondary level.

3) While need cannot be accurately assessed, there are bits of information that throw some light on the matter. For example, the EHN project, after the expenditure of 2.5 million, has only "interested" one publisher, the same one which published MACOS. One would think that, if there was a real need, a number of commercial publishers might express serious interest. Moreover, the CPE project is hardly revolutionary and the materials which it offers, although highly biased, are far from original in approach and could easily be duplicated by any number of commercial publishers at a fraction of the cost. Indeed, at the college level, such materials have been produced, albeit in more sophisticated form. This fact tends to undercut the claim of need.

(D) The CPE project by all evidences is fairly far along (more than 1.2 million expended to date) and the fact is that no adequate appraisal of its output has yet been made. This is, in my judgment, a very serious shortcoming. There is need for a review by disinterested political scientists, i.e., political scientists not connected with the project in any way, past or present.

(E) The ten question format designed by NSF simply precluded panel consideration of certain basic matters such as those I have mentioned. Those who read the committee report should at least be apprised of this fact.

Panelist: Mr. Coe Dexter

In general, I support the panel's conclusions and recommendations concerning this curriculum project. As stated in the report, only a small portion of the materials were available, and those that were available were in rough draft form. Much further work will be needed to prepare these materials for general classroom use.

As the project developers have claimed, there is a clear cut need for materials to be used in high school psychology materials. However, I believe that the developers should carefully reassess their objectives. I believe that there is a need for materials to be used in teaching the elements of psychology to high school students. However, the development of materials which could create a clinical situation between teacher and student is less justifiable. While it is logical to expect that students should learn basic understandings which are applicable to real life situations, it is not as logical to assume that what a student learns in a psychology class automatically will help that student solve his or her personal and/or emotional problems.

As stated in the report, a higher than usual degree of teacher expertise would be required, if the materials were to be used effectively. The teacher guides should be carefully written in order to insure the optimum use of the materials. Additionally, as some of the suggested activities might have psychologically threatening overtones, the guides should point out to teachers the potentially fine line between teaching psychology and providing clinical psychological services.

There is no doubt that some of the modules, both in subject matter and in process, will provoke controversy in some, if not in most school districts that adopt the program. School districts which indicate an interest in using these materials should be encouraged to frankly discuss possible areas of conflict with interested parents.

The project developers should be commended for the care that they have taken to insure the professional quality of the materials. The monitoring and review process should be continued, and include educational specialists, parents, and lay persons. The controversial nature of such materials, rather than bar their further development, should provide an inducement to develop the highest quality materials possible.

Panelist: Mr. David Engstrom

No comments submitted.

Panelist: Mrs. Verna S. Fancett

Social studies teachers would probably agree that there is a need for materials that will help students to understand their own behavior and that of others. They would probably also agree that there are some areas of investigation that are neither necessary nor appropriate. Project developers should start from this premise when selecting topics to include in their materials.

Because the project is in the early stages of its development, few modules were available for review. Several would be entirely appropriate and useful in a secondary social studies course. Others such as "Family Counseling", "Animal Behavior and Man", and "Behavior Modification" would be either beyond the needs and abilities of many students or highly objectionable to many students and parents. In addition, the fact that students would be placed in clinical situations with their peers and others makes some of the methodology highly questionable.

The value of review at the early stage of project development is that decisions on redirection can be made and weaknesses or objectionable materials can be eliminated, before more time and money is spent. The final product then will be more valuable to teachers and students and the market for the materials will be greatly expanded.

Panelist: Dr. John C. Linehan

Many of the modules are planned (thirty to forty) few (less than ten) were available for evaluation. The modules available were only in a "rough draft" condition. One module, Family Counseling, should be eliminated, or completely revised. In my estimation the contents and learning techniques are extremely controversial.

The "module" format is excellent. School systems and instructions will be free to choose appropriate "mods", according to cost, class and even student needs.

The cost of items such as teaching materials, teacher training needed, are so incomplete that estimates were not available. If competitive, I see a great potential and need for this type of project.

The modules should not be organized and marketed in book form, for then it would lose its flexibility and uniqueness.

I would enjoy reevaluating this project as it nears completion.

Panelist: Mrs. Kristina McGough

I have real concerns with some of the proposed module topics given the teaching mode which is used. Some of the techniques appear to be severe invasions of privacy and the idea of using students as experimental subjects sets an unwise precedent in public school education.

I find some of the curriculum material to be incredible. In my opinion, the keeping of a sexual experience diary (Family Counseling) and the role-playing of brain damaged adults (Nervous System) are two such examples.

I would definitely discourage my children from taking this course, and I am extremely concerned that there is a possibility that these modules could be inserted into a "variety of subjects."

I do not believe that the Federal Government should be funding courses which permit experimentation with public school students.

Additional General Comments:

I am basically in opposition to federal involvement in curriculum areas--by its very nature it tends to remove control of education from the local community. By the time the community has a voice in deciding whether or not to adopt a given curriculum, many millions of public tax dollars have already been spent.

As a layman, it was startling to read of the elaborate diffusion projects involving NSF curricula. Although there is much talk of "needs assessment" in the grant proposals, the diffusion projects seem to contradict this. At the risk of sounding like the little boy in "The Emperor's New Clothes" who is pointing out the obvious--if there was such a great national need for some of these curricula, why does the government have to spend tax dollars to "sell" them to the citizens? In the case of some curricula I've seen, we could be in the position of financing the man who is selling us the snake oil. As a parent I was shocked to see the lack of parental input at the proposal stage.

Since I realize that there may be instances in which the resources of the Federal Government may be useful in the development of certain curricula, I wonder if this might not be handled better by funds to the states with close monitoring by NSF and a legal requirement for citizen involvement during the development stage. Also, since many federal projects are experimental in nature, I see no way that proper needs assessment can be carried out without involving parents. Since it is our tax money and our children who are used, it seems to me we should have a voice in deciding whether we "need" a particular program.

I am concerned about the ethics of student participation in experimentation.

Panelist: Dr. Michael K. O'Leary

There is an important and continuing role to be played by NSF in supporting innovative social science materials that are sorely needed in American education. However, projects such as EHN, CPE, and HB should be funded only on the basis of documented needs, supported by evidence systematically gathered from social science teachers and local community representatives.

In funding proposals and in monitoring development, NSF should concern itself with the market for the materials produced. This entails satisfying the criteria of (1) meeting identified needs, (2) flexibility of educational uses, (3) low cost, (4) quality of the materials and (5) avoiding widespread rejection by teachers, administrators and the communities in which the materials will be used.

Projects funded by NSF should pay equal attention to the development of both the teacher and the student materials. Teachers' guides should be developed which minimize the need for specialized, costly in-service training and which enable teachers to implement the program adequately, even if they are not specialists in the discipline being covered.

Panelist: Ms. Juliana Podraza

The Human Behavior project would seem to be enticing to the average high school student; however, the reading level is for high ability students.

The project is in rough form and too lengthy; perhaps this can be rectified in later drafts. The content of some of the modules should be modified to avoid possible rejection by parents. Other modules are repetitious of content and activities already studied in required courses or offered in optional courses. This overlapping should be avoided to enable more psychological material such as the sleep and consciousness issues to be included.

Due to the high intellectual and intense psychological nature of the modules, special teacher training would be obligatory for the teacher handling this program. Since this project is in the early stages of development, it should be monitored to enable the developing scholars to employ some of the suggestions of the reviewers.

Panelist: Dr. Ethel Tobach

In answering question 10, I believe a statement of my rationale for approaching "Exploring Human Nature" and "Understanding Human Behavior is necessary.

1. The science of behavior should be taught through the integration of concepts of evolution, development, physiology, anthropology, sociology and psychology.

2. Today biology, anthropology, sociology and psychology as academic disciplines deal with many aspects of behavior, both on the human and non-human animal levels. All are concerned with ecological issues, and thus by implication, problems of adaptation and environmental processes

   It is thus difficult to integrate the professional disciplines in the development of teaching materials (see Dr. John K. Bare's application and statement about the 1967 conference called by APA) because each discipline is interested in developing its own educational program because of needs to respond to the professional futures of the membership of the professional organizations.

3. Behavioral science, more than any other science, is intimately related to societal processes--its value systems, its governmental and community organizations, its codified forms of responsibility between citizen and government. Therefore, it is most important that in developing programs for teaching any one of the behavioral sciences that all those concerned be involved: students, teachers, educational administrators, parents, governmental agencies and administrators, and <u>institutions which train teachers</u>.

   These populations should be involved in every aspect of the teaching-material development: conceptualization of a possible need; determination of the need; conceptualization of ways to satisfy the need; evaluation of the success with which the need was met; future planning.

4. The educational process, once it is the product of the integrated activities of the groups mentioned in "3" above, should then be carried out by individuals who are trained in presentation of the substantive material. The learning process should have the support of specialized personnel to aid in the activities which guarantee that the students and teachers are operating at their maximum efficiency; if students or teachers require individualized instruction or counselling for personal emotional-social problems, that kind of professional service should be available to both. The teacher and the student should not stand in any type of

clinical relationship to each other. It is hoped that the teacher will be a true educator, sensitive to the behavior and needs of the student and able to maximize the student's learning. Where the teacher is unable to do so, the possibility of eliciting help from other resources should be real.

Therefore, the material developed for the teaching of behavioral science should be organized to present the student with the currently accepted information about a field of knowledge; where that information is still debatable because questions have been raised about the scientific validity and reliability of the material, the students and the teachers should be made familiar with the issues involved, the most widely held viewpoints on the matter and the need for further research to resolve the issues. THIS IS THE MOST IMPORTANT THING THAT STUDENTS CAN LEARN ABOUT ANY SCIENCE: THE STUDENT IS BEING TAUGHT THE PRESENTLY ACCEPTED KNOWLEDGE--AND SOMETIMES SCIENTISTS THEMSELVES ARE NOT IN AGREEMENT. THE STUDENT CAN THEN BE LED TO UNDERSTAND THAT THERE IS PLACE FOR THE PARTICIPATION OF NEW SCHOLARS IN THE ELABORATION OF NEW KNOWLEDGE.

REMEMBER: "THE WORLD IS ROUND."

I also recommend that the relationship between the programs in "Exploring Human Nature" and "Understanding Human Behavior" should be reviewed and integration between the two realized.

1. These two programs should be integrated and should represent the work of the evolutionary biologist, the developmental biologist, the geneticist, the anthropologist, the psychologist and the sociologist. There is too much overlap among the current curricula in the different disciplines. If the various disciplines cannot work together, I would be so didactic as to say that no discipline should receive any support for a program that is already represented in the integrated program. The disciplines should be aware that if they cannot work together, they cannot get support alone.

2. In both programs, there is too great a possibility that by appealing to the self-interest of the student in personal problems, the substantive materials of the disciplines are under-emphasized and the more "romanticized" aspects of behavior will be overemphasized. The material that is being studied should enlighten the student about the relationship between individual and social behavior, and should inform about ways in which individuals can receive the guidance and counseling that might be wanted. However, the classroom work should not be a substitute for that kind of professional service.

3. As a comparative psychologist (evolution of behavior) I am most distressed at the kinds of modules chosen in the Human Behavior program and the fact that this area of psychological science was not represented except in the EHN. Please be aware of my personal bias in this respect.

Finally, I would like to make some general statement about the activities of the National Science Foundation and its role in science education. In order to do so I would require more information than I have available to me. Some of my questions are:

1. What is the relationship between the Office of Education and the NSF function?

2. Has standardization of scientific material to be disseminated been discussed by federal, state, and municipal educational agencies?

3. How much relationship is there between these NSF activities and curricula in teacher-training institutions?

Without the above information my remarks are undoubtedly limited in their usefulness. However, the questions indicate my concern. First, I am in favor of a standardized science curriculum in those areas of science where controversy is at a minimum; in this instance the definition of "controversy" is moot. (Please see my other remarks about the sensitivity of the interface between society and all behavioral sciences.)

Second, I believe the efforts being made by NSF are to be encouraged and supported. They do not go far enough. Integration among NSF, Office of Education, and above all teacher-training institutions is essential.

I am grateful at having had this opportunity. I hope that my "learning" experience on this panel resulted in my being constructively contributive to the NSF and to science education.

D. 15. a: CPE: NSF Descriptive Information

PROJECT TITLE: High School Political Science Curriculum Project: Comparing Political Experiences (CPE)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Howard D. Mehlinger

INSTITUTION: American Political Science Association

DEPARTMENT: Social Studies Development Center

BUDGET: Total Granted: $1,261,900

Dates: 3/13/72 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Development of alternative materials for 12th grade government courses.

PROJECT SUMMARY

OBJECTIVES

The main purpose of the high school project is to develop, test, and diffuse an alternative approach to high school courses in American government. A course in American government is offered in nearly every American high school, is required for graduation in many states, and enrolls more than one and one-half million students annually.

The "alternative approach" under development by the high school project is a two-semester program, entitled Comparing Political Experiences. The program is designed so that each semester program can stand alone and be taught separately, or they can be combined to form an integrated, full-year instructional program. One-half of the course can satisfy the typical demands of a one-semester American government course; the other half will meet many of the goals for a problems of democracy course.

ACTIVITY PLAN

The major steps in the Development Cycle used by the High School Political Science Curriculum Project are:

1. Design and conceptualization

2. Preparation of prototype materials according to design

3. Testing of prototypes

4. Preparation of complete unit or course in accord with modifications of prototypes

5. Testing of unit or course

6. Revisions of unit or course on basis of testing

7. Final testing of program

8. Preparation of commercial version for publishers and of final report

ORGANIZATION AND MANAGEMENT

Howard D. Mehlinger has ultimate responsibility for the High School Political Science Curriculum Project to the American Political Science Association and to the National Science Foundation.

Judith Gillespie, Howard Mehlinger, and John Patrick share responsibility as co-directors ~~of the~~ high school project. Ms. Gillespie and Mr. Patrick have primary responsibility for the design and development of the instructional materials. Dr. Mehlinger has overall administrative responsibility and is in charge of the diffusion activities of the project.

HISTORY AND RELATED PROJECTS:

In 1972, NSF made a grant to the American Political Science Association (APSA) to support an elementary school political science curriculum study and a high school political science curriculum development project. Support to date for the high school component totals $1,261,900.

Since 1972 the project has completed the design and conceptualization of the program, including publication of a monograph: Comparing Political Experiences: An Alternative Program for High School Government Instruction, which provides detailed guidelines and a rationale for development of the course. Ten prototypes were developed and tested; the first semester of the course has been prepared for pilot-testing in 1974-75, and a revised version was tested in the fall semester of 1975-76. The second semester of the course was prepared for pilot testing in 1975-76. It has been tested in the fall semester and will be retested in the spring semester of 1975-76. An increasingly large number of pilot schools has been used each year.

In selecting pilot schools to try out the semester course, attention has been given to a mix of variables including type of school setting, geographic region, socio-economic classes and ethnic groups, and type of political system in the school. A consultant network has been identified which provides social scientists to work with each pilot school. These consultants are active in diffusion activities already underway. Project staff members are active in many additional activities including published articles, presentations at meetings, etc.

Major revisions of the first semester have been undertaken, based on student and teacher reactions. One result has been to cut back on the amount of materials, reducing the four units to three. Units to be tested in the fall of 1975 for the first semester course entitled Political Systems are: Unit I - Observing Political Behavior, II - Using Political Resources, and III - Participating in Political Activities. The second semester materials are entitled Political Issues. The second semester includes "Save the System," an introduction to political systems for students who have not used the first semester materials, and units on Busing in Boston, Clean Air Now, Union Underground, and Jobs and Engines. These materials will be pilot tested for the first time in the 1975-76 school year.

PERSONNEL:

Project Director: Howard D. Mehlinger: Ph.D., University of Kansas. 10 years' experience teaching history and American government in Lawrence, Kansas. Member, American Political Science Association's Committee on Pre-Collegiate Education. Member, Editorial Board of Division of Educational Affairs News (DEA News) of APSA.

D. 15. b: CPE (panel 3): Project Director's Response to 10 Review Questions*

Introduction. In Dr. Harvey ~~Averch's letter of~~ November 11, he invited me to send him our project's "perspectives and viewpoints" relative to the ten questions the panel has been asked to consider while appraising our work. This paper is our response to his invitation. In it the panel will not find "answers" to the ten general questions or to the many sub-questions which followed them. It would be presumptuous of us to attempt that, as each of the questions calls for judgments that only the panelists can make. Therefore, my colleagues and I have tried merely to provide a commentary on some of the points raised by the questions. The responses contained in this paper should be seen as supplementary to the information I sent Dr. Averch in my letter of October 9, 1975, to the mimeograph overview of the Comparing Political Experiences course, and to the instructional materials themselves: all available to the panel. This paper, then, provides additional information of the kind that might not be available in each of the other sources or might be difficult to identify, the kind of information that might be offered during a conversation if we had the opportunity to chat about the project. I hope you will find this paper helpful.

Question 1: Is there a genuine need for these instructional materials?

Courses in American government have been a staple of the high school curriculum for more than fifty years. Currently, more than 1,600,000 students enroll in these courses each year.

We believe that teachers and students need alternatives to the standard government and civics courses. This belief is based on evidence about (a) the style and content of leading textbooks in government; (b) the impact of instruction on the political learning of high school students; (c) the interests of high school students; and (d) trends in opinions and practices in political education.

The Style and Content of Leading Textbooks. Widely used textbooks feature the study of governmental institutions but ignore politics. These books tend to be very similar in content and style. They follow a format set by the best-selling textbook, Magruder's American Government, which was first published in 1917. Although political science has changed markedly since 1917, the conceptual frameworks for courses in civics and government have changed very little. Thus, an enormous gap has developed between knowledge and methodology in political science and the content of high school government textbooks. These claims about the content of high school government textbooks are substantiated by a content analysis of leading texts conducted by a number of our project staff.[1]

The Impact of Instruction on Political Learning. Studies of the impact of instruction on the political learning of high school students were reviewed by one of our project staff members.[2] This review of research indicated that typical courses in American government and civics do not contribute significantly to the learning of political knowledge, attitudes, and intellectual skills.

*This response is supplementary to a letter by the Project Director dated October 9, 1975. This will be made available on request to Acting Assistant Director for Science Education, NSF.

Another way to look at the possible impact of public school political education is to examine surveys of the political knowledge of adults. Since a large majority of American adults have graduated from secondary schools, the long-term impact of formal political learning in schools can be assessed roughly through the findings of nation-wide survey studies of the adult population.

A recent survey by Louis Harris and Associates, conducted for the U.S. Senate Subcommittee on Intergovernmental Relations, demonstrates massive political ignorance among nationally representative samples of adults. Less than forty percent profess to be well-informed about government or current political events. Less than half of the respondents could name both of their Senators or the representative to Congress from their districts. Less than two-thirds knew that Congress is comprised of the House of Representatives and the U.S. Senate. Twenty percent said Congress consisted of the House, the Senate, and the U.S. Supreme Court -- this after all the textbook preachments about the three branches of government. Lou Harris' observation about his survey is that "these results indicate substantial gaps in the public's knowledge of both the structure of government and also of many of the key individuals elected to high office."

An important objective of traditional government courses has been to transmit information about governmental institutions and politics. Although the traditional approaches have dominated the public schools, the impact of these courses in the political knowledge domain (as revealed by various survey studies) has been meager

<u>The Interests of High School Students</u>. A study by Richard Remy in 1972 of 1,600 high school students revealed their dissatisfaction with standard high school courses in government. These students wanted to learn how to analyze and evaluate political life rather than to learn information only. They wanted to study important political and social problems and issues as well as government institutions.[3]

<u>Trends in Opinions and Practices in Political Education</u>. The staff conducted a systematic search of the literature about opinions and practices in education in the schools. One of the striking characteristics of the literature in 1970-71 was the spurt of interest in programs that involved student internships and participation in government agencies, such as mayors' offices, welfare agenices, etc. Another trend in the literature was concern for the "hidden curriculum" in schools. Some writers argued that civics instruction was being systematically undercut by the structure of the school itself and what it taught students about the relationship of government institutions and individuals in our society.

Findings of the kind described above led us to conclude that a need existed for a fresh approach to the study of politics and government in the schools. It seemed unlikely that commercial publishers would launch such efforts. It seemed appropriate that a federally funded curriculum development project should undertake the development and testing of a new approach to the study of politics and government in American high schools.

Question 2: Is there a market for these instructional materials?

The main curriculum slot for the Comparing Political Experiences course is the twelfth-grade course in American government. This course is offered in most American high schools; at least one semester of American government is required for graduation in many states, especially those in the Midwest and South. Thus, Comparing Political Experiences will not ask schools to add a new course; rather it will invite teachers to substitute a new approach for what they have done in the past.

It will not be easy to convince a large number of American government teachers that they should give up traditional practices regardless of how out-of-date their textbooks may appear to some critics. The fact is that a particular approach to the study of American government has been dominant in the schools for fifty years. Indeed, one textbook has enjoyed a near monopoly on the American government market during most of this time, despite the efforts of many publishers to compete with it.

The traditional approach to the study of American government in high schools might be termed a legal/institutional perspective. The principal focus is on the institutions of government and the formal rules, including the Constitution, that direct their behavior. Certainly, this is one valid approach. And, since publishers have had an opportunity to create textbooks embodying this approach for nearly 50 years, the textbooks are generally sound -- at least with respect to this perspective.

In our opinion it would have been an error for NSF to support a project whose main purpose was merely to do better -- e.g., make more pedagogically interesting -- what publishers had been producing well for many years. A curriculum development project can be justified only if it tries to blaze new trails, thereby breaking the circle in which publishers produce what they think teachers want because that is what they buy and teachers buy what the publishers produce because that is all they have to select.

Comparing Political Experiences is directed at the American government slot, but it devotes less attention to government institutions than do traditional programs. Its focus is on the everyday political experiences of typical citizens, while trying to demonstrate that the common political experiences faced by all are not wholly unlike those that confront people in public office. We believe students will know more about politics from taking our course than they would by taking traditional courses; we also believe they will be more competent politically and more reflective and respectful of the political process.

Despite the challenge CPE presents to traditional programs, we believe the program is commercially viable. Several publishers have expressed a strong interest in it. In the beginning, we believe CPE can find sufficient customers among those teachers who are weary of traditional approaches to justify commerical publication. Later, as CPE becomes better known, it could become one of the top three programs in American government.

Question 3: Do these instructional materials possess a clear purpose and rationale?

Comparing Political Experience is a bold attempt to prepare young people to become competent political actors in whatever settings they find themselves. Competent political activity requires knowledge, skill, experience, and a capacity to make judgments about the kinds of activities that are appropriate and those that are not. We assume that only a small fraction of students will ever run for political office, but the majority will find occasions to join with others in some kind of political activity. Acquiring the competence to act on behalf of a group and for one's own interests is part of what education for "responsible citizenship" is all about.

While the underlying rationale and objectives can be clearly stated, their achievement is not easy. First, it is necessary to understand political systems within a comparative framework in order to grasp how political activity in a school resembles that in more complex kinds of political systems; students must acquire certain basic intellectual and methodological skills; and they must have an opportunity to practice their new skills if they are to become proficient. Thus, the school becomes a kind of laboratory for testing propositions about politics and for honing political skills.

The course materials are not yet perfect. Some lessons work very well; others fail miserably. But they are still in an early experimental stage of development. The Political Systems course has been tested only once before this year. Political Issues is experiencing its first field test currently. We learn new ways to improve the materials daily.

It would have been easy to devise a traditional American government course. There are plenty of models available for doing that. But rather than asking students to observe from a distance important political figures such as the President and Supreme Court justices, we are placing our emphasis upon the student as political actor and on the school as one institution for which students have responsibility. Schools that wish to concentrate their energies on teaching students about institutions of government will probably choose other programs; teachers who wish to help students become effective, responsible citizens in their everyday lives may elect to use CPE.

Question 4: Is the content of these materials scientifically correct?

The main purpose of the program is to provide political science knowledge that will be useful to students in their everyday lives. No effort is made, or should be made in our opinion, merely to "represent" the discipline in a simplified way. We are not trying to teach the "structure" of political science, as might have been done by curriculum projects in the 1960's. We are using the discipline of political science as a source of relevant information to satisfy what we believe are broadly shared educational goals.

Nor do we see ourselves engaged in pre-college instruction of political scientists. We are engaged in citizen education. Most of our students will

not attend college; very few will find professional careers in politics or political science; but all will be citizens, confronting opportunities to make political choices and to take action to support their choices.

Political science is not a single, unified field of study. ~~It is~~ a diverse field of study, representing a wide range of specialized concerns. No single project could represent the discipline. The best we can do is treat honestly and validly those portions that touch on our interests. We have drawn extensively upon work in systems theory, comparative politics, and public choice theory.

Question 5: Is the content of these instructional materials educationally sound?

Whether potential users will find the published version of the CPE course educationally sound depends upon our ability to find acceptable answers to a number of questions during the experimental testing of the materials. Some of the most important questions facing us are the following:

How much traditional American government content must be included to make the program adoptable? We are attempting to offer CPE as an alternative approach to the study of American government without presenting all of the traditional materials found in typical government textbooks. CPE will offer a number of advantages not presently found in traditional texts. However, the tension we feel is how far can we go in helping students become more competent political actors in familiar settings without losing American government teachers, and how much traditional American government content can be included without undermining the comparative model that holds the course together? The answers to these questions are not easy. In seeking answers, we are consulting with teachers, state department of education social studies supervisors, city social studies supervisors, and textbook publishers.

Will the four units for the "Political Issues" portion of the CPE course be judged as significant and worthy of study? The design of the Political Issues semester of CPE responds to several problems we face. First, many states require only one semester of American government. Political Systems is hopefully capable of satisfying this requirement. On the other hand, many school systems offer or require a full-year of American government. Therefore, Political Issues is designed to serve as a logical continuation of the Political Systems semester. Other states match a one-semester elective in "Problems of Democracy" with a required American government course. Hopefully, Political Issues can be accepted as a good solution to the "American Problems" course.

A second issue regards the characteristics of the "documentaries" we have chosen as the foci for each of the Political Issues units. Of course, the unit, "Busing in Boston," is not about busing in Boston but about political conflict. But will teachers perceive this as we do? Will "American Problems" teachers judge our topics to be sufficiently significant to deserve extensive study? The topics were selected because they represent experiences we believe will be common to most students taking the course: school ("Busing in Boston"), labor unions ("Union Underground"), business ("Jobs and Engines"),

and community issues ("Clean Air Now"). Organizing each unit around an extensive documentary was our response to a persistent suggestion from teachers: The students like case studies; give them some that provide sufficient detail that they begin to comprehend fully what has occurred. Long documentaries leave somewhat less time for treating the comparative examples. Have we gone too far? Hopefully the field testing currently underway will provide clear answers to this question.

Will the attention given to "moral reasoning" offend schools? There seem to be two issues here: 1) Should the program deliberately provide occasions for students to consider the consequences of and the ethical justification for their actions; and 2) Is the term "moral reasoning" likely to be controversial? The second question is the easier to face. If the process of moral reasoning is important to include in the course but the term is controversial, we can give it another label. However, we believe dropping the process itself would be a mistake. The course attempts to raise students' political competence, to help them become more effective political actors. Should the course succeed in achieving this difficult goal without simultaneously heightening the concern and capacity of students to reason thoughtfully about the consequences of their actions, the course may prove to be of little service to the society as a whole.

Will the "school as a lab" concept be controversial? To our surprise the use of the school as a laboratory for helping students practice political skills has not prompted the anxiety on the part of school officials we had anticipated. This is not to say that this feature of the course may not lead future, potential clients to hesitate before adopting the program. But our main problem in using the "school as a lab" is that for many students, school has lost much of its appeal. A great many seniors attend school only to receive the course credits necessary for graduation. They are not active in school organizations and extracurricular activities. Many have jobs after school; many climb aboard buses immediately after school and return directly to their homes. At the present time, our main dilemma is not how to put out "brush fires" caused by using the school as a lab; it is how to find appropriate settings that permit students to practice the skills they are learning in class.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

We assume that students using Comparing Political Experiences will achieve significant gains in political knowledge, intellectual skills, and participant skills. These achievements should enable them to view their political world more realistically and insightfully, to think about it more aptly, and to act within it more effectively.

The CPE course features lessons requiring students to be active learners. They are asked continually to use information, ideas, and skills. The aim is to prompt them to transfer learning from the classroom to the "real world."

Students are asked to use their school or community as settings to develop intellectual and participant skills, by applying knowledge and skills learned in the classroom to problems in the world outside the classroom. For example, they conduct surveys and systematic observation studies in their school and perform participant roles in groups in their school or community. We believe that students and teachers will respond favorably to a course that links academic learning and action and that stresses the broad transferability of learning.

The CPE course may offer other contributions. Perhaps, by linking classroom instruction to the life of the school itself, high schools will become more interesting and appealing to those students who are currently "turned off" by school. At a minimum we will have created an alternative to existing instructional materials available to teachers, thereby increasing their options and hopefully encouraging publishers to add to the range of alternative approaches.

Question 7: Do these instructional materials present implementation problems for the school?

The course is designed to slide into an American government or "Problems of Democracy" slot at the twelfth grade in most high schools. It will not be necessary to alter the structure of the school curriculum to accommodate the course. All that is required is a teacher who is dissatisfied with traditional textbooks in this field, who shares our goals, and who wishes to try a new approach.

If we are successful, the course will have its greatest appeal to "average" students, the kind of student who is not particularly attracted now to the study of government and politics. Clearly, we do not wish to turn away bright, academically inclined students, but this is not the population we are seeking primarily. The course is no more likely to succeed with very poor readers than most other products on the market.

Teacher education. We are striving to devise a program that will make a massive teacher education program unnecessary We are exploring the feasibility of producing a short and inexpensive teacher "kit" that might be used by a teacher operating singly or by a school system for in-service eduation purposes for those teachers who express an interest in receiving some kind of introduction to the program. But in general, we believe that if we are unable to make the program sufficiently clear to teachers in order that they can teach it comfortably, we have little reason to believe the students will be any more successful.

Question 8: Are the costs for implementing these instructional materials reasonable

Our present method for packaging the course is the most practical and inexpensive we could imagine for the experimental testing of the program. It enables us to produce and send promptly instructional materials to the pilot schools shortly after they have been written; it also permits us to test a variety of pedagogical approaches at a relatively low per unit cost.

To date, the staff has made no final judgment regarding how the published version of the course should be packaged, other than it must be done in such a way that it fits the instructional budgets of typical schools. Most American government books currently sell for about $9.00. CPE must be able to compete at that price.

We have deliberately adopted a conservative attitude toward audio-visual items. At the present time, audio tapes, filmstrips, and transparencies for the overhead projector satisfy all of our major audio-visual support requirements. These can be marketed inexpensively. We are not certain at this time whether the skill exercises should be included in the text, as is the case of the Political Systems course, or appear in a separate package, as we are testing with the Political Issues course. This is the type of question that will be resolved finally in collaboration with the publisher who wins the right to publish the program.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

It might be helpful to explain how project activities are conducted. The designated director of the project is Howard Mehlinger, who is employed 50% of his time by the project. His main responsibility is to exercise general management over the project, to maintain liaison with NSF, the American Political Science Association, and Indiana University, and to plan the diffusion activities of the project. Internally, Judith Gillespie and John Patrick are also co-directors. From the beginning of the project, Gillespie, Mehlinger, and Patrick have shared equal responsibility for making critical choices over the direction of the project. Gillespie and Patrick are both employed full-time by the project. Together with Stuart Lazarus, they are the principal developers of the instructional materials. Toby Bonwit, employed only this year, works as both a writer and as an editor on a full-time basis.

There are four graduate assistants. While they perform a variety of tasks, two are mainly responsible for gathering and processing the evaluation data from the pilot schools, one is responsbile for servicing the pilot schools, and the fourth has served primarily as a part-time writer.

We have employed two "teacher associates" during each of the past two years. These are teachers who have received sabbatical leaves from their school systems for one year to work in the Social Studies Development Center. The school systems pay one-half of their salaries; we pay the other half. In addition to being the source of constant friendly advice regarding what can be reasonably expected of schools, the teacher associates visit pilot schools to observe the course in action and present the project to teacher conferences.

The project employs three full-time secretaries. It has also employed a wide variety of people for short-term assignments. These include writers, cartoonists, illustrators, audio-visual technicians, and critic readers.

The project has been reviewed at each stage in its development by many people representing various constituencies. We have used political scientists, social studies specialists, state department of education personnel, commercial publishers, city social studies supervisors, teachers, and school administrators. We have not found a way to draw a representative sample of lay people or parents to serve as course critics. We are reluctant to ask pilot teachers to arrange for such reviews for fear that we may merely create continuing problems for a school or a teacher where none has existed before. On the other hand, we are uncertain how to bring together a representative set of parents or lay people for a meeting we might call. We are open to advice on this issue.

This year, we have contracted with National Evaluation Systems in Amherst, Massachusetts to conduct a validational study of the course materials. Copies of their test items are on file at NSF.

Question 10: What are your general impressions of the curriculum?

It would be somewhat presumptuous for us to comment on this question other than indicate that we look forward to receiving the panel's suggestions and recommendations.

Notes:

1. Judith Gillespie, "Relationships between High School and College Instruction," Teaching Political Science, Vol. 2, No. 4 (July, 1975) 381-408.

2. John J. Patrick, Improving Political Learning in Secondary Schools. Paper presented at the 1972 Annual Meeting of the American Political Science Association, September 9, 1972.

3. Richard C. Remy, "High School Seniors' Attitudes Toward Their Civics and Government Instruction," Social Education, Vol. 36, No. 6 (October, 1972) 590-597.

D. 15. c: CPE (Panel 3): Panel Responses to 9 Review Questions

NSF Staff Note: Panel 3 completed a first draft of the review of this project by December 12 and selected a 5-member "editing committee" from the panel to work on a final draft. A typed copy of this first draft was circulated to all panel members in January for their comments and reactions. The "editing committee" met with the Panel Facilitator on January 24, 1976, reviewed the first draft, the comments of other panel members and prepared a final draft of the review for mail circulation to the entire Panel. One panelist submitted additional written comments on the final version included at the end of this section.

Question 1: Is there a genuine need for these instructional materials?

In our judgment, the project developers have demonstrated, both in the original proposal of September, 1971, and in subsequently developed materials, that there is a need in the secondary school social studies program for materials of this type. In the original proposal eight purposes for high school political science courses were identified. The proposal stated: "...few of the educational purposes that should be served by pre-collegiate political science education are in fact well served by the corpus of instructional materials that most schools currently use in teaching children about man's political life."

A wide variety of curriculum and instructional materials currently do exist, but as the project developers indicate, these primarily reflect the structural-institutional approach to the study of government. None of the available materials took the approach advocated by the developers. They contend that the style and content of the standard government textbook have varied little since the original Magruder's American Government was published, while government and political science have undergone tremendous changes.

The fact that pre-collegiate political science education has been relatively ineffective has been substantiated by a poll recently conducted by Louis Harris and Associates, and cited by the project developers. This poll disclosed that there was "...massive political ignorance among nationally representative samples of adults." Moreover, many students are dissatisfied with a curriculum which emphasizes only the structure of government, but which fails to teach them how to participate actively in a democracy.

Question 2: Is there a market for these instructional materials?

An abundance of published materials is available for secondary-level American government courses, but the CPE program aims at a new approach. Other products with this particular approach are not available.

The materials could be used in many required high school courses on American government or civics. However, the curriculum requirements of some states are such that a new course would have to be added to utilize this approach.

The developers state that the program is commercially viable and that several publishers have expressed a strong interest in it. It is the panel's judgment that there would be a market but we are in no position to judge how extensive it would be.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The CPE materials possess ~~a clear~~ purpose and rationale: the preparation of young people to become competent political actors. The program encourages students to participate in political activity within the school, which is the laboratory for testing CPE's propositions about politics and political skills. The major inference of the program is that political skills practiced in the schools can be applied in other situations leading to responsible citizenship.

Question 4: Is the content of these instructional materials scientifically correct?

The materials employ accepted concepts in political science; e.g. Political Systems, Political Roles, and Political Resources. The materials likewise examine the political process outside of formal government institutions. This is consistent with the current state of the profession of political science and is specifically responsive to the goals of the American Political Science Association's Committee on Pre-Collegiate Education. The result is that the materials are clearly aimed at preparing a scientifically literate population and not solely at preparation of future scientists.

The panel felt that the materials emphasized breadth rather than depth. In at least two cases, the Mayor Daley case and the ERA episode, the materials may appear biased because they do not cite varying scholarly approaches. We realize that the developers have presented these cases to illustrate specific political concepts and not to present a total picture. For this reason, the use of such studies requires teacher awareness of this method and its limitations. Similarly, it should be made clear to students that such materials do not contain full accounts of the cases but only illustrate selected concepts.

Question 5: Is the content of these instructional materials educationally sound?

In general, the content is basically sound. The course reflects the belief that students "learn by doing" and places emphasis on active participation. In addition, the learning arena is one with which students are familiar - their school. The development of process skills is an integral part of both required and optional student activities.

In addition to CPE's presentation of the study of political processes, students may need an adequate background knowledge in United States history and government. In those programs where CPE would provide the

only study of government the course provides opportunities for the teacher to introduce supplementary materials dealing with the Constitutional system of the United States.

The Teacher Manual contains many sound instructional ideas for course enrichment. The program provides opportunities for student selection and participation in the activities. In addition, it is geared towards the average reader. The student manuals seem to include many pedestrian programmed learning exercises which may occupy too much time and encroach upon the "action" part of the course.

There are three principal features of the course which may generate adverse reactions. Some people may object to the use of the school as a forum for practicing political participation skills. Others may object to the fact that some of the activities involve moral dilemmas. Still others may dislike the interviewing or other assignments felt to involve sensitive activities with the school staff, administration and other students. However, many of the features which promote adverse reaction by some, will make the course highly appealing to others.

Whether these adverse reactions are exacerbated or minimized depends on several factors. Most important, the Board of Education, school administrators, parents, and others must be aware of the implications of the course before it is adopted. Likewise, adequate preparation for conducting the course will greatly influence its acceptance by the community.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

The developers have had two main objectives: to offer an alternative to the traditional approach to the study of American government at the senior high school level, and to prepare the students for more effective political participation through acquaintance with political science concepts and through participation in political processes within the school. The panel finds both objectives desirable and feels that this course will fulfill the first objective and will make a contribution to the second. Some members believe the limiting of participation solely to the school environment is unfortunate and that the course would be strengthened by participating in political processes in the wider society. In addition, some students may benefit from additional understanding of more formal governmental institutions and processes.

There is one feature of the use of cases to illustrate concepts that needs more treatment in the teacher's guide if students are not to be misled. Concepts pick out selected aspects of reality for analysis. No one concept pretends to deal adequately with all aspects of a case. For example, students are shown Mayor Daley only in the context

of an elite system and may think this is a complete analysis of his role as mayor of Chicago. On that incomplete evidence they may inadvisedly make a value judgment about his whole performance. The same possible misinterpretation applies to other case materials in the course.

In general, the panel believes that the developers have presented situations without distortion. They regard the effort being made as an intelligent and promising one. A change that should be considered is to substitute more data drawn from actual events in such units as "Busing in Boston" to replace the fictional scenes portrayed. Although the developers have used audio-visual materials tellingly at some points, they could perhaps do more--recordings of actual confrontations in the streets of Boston, for instance.[2]

Question 7: Do these instructional materials present implementation problems for the schools?

The implementation problems related to the adoption of CPE materials are varied but by no means insurmountable. One change to be expected, that could become a problem, is the required change in "climate" within a school. The program requires the cooperation of staff and administration, including the allowance of student mobility throughout the building and the encouragement of student investigation of administration and faculty decision making techniques.

Question 8: Are the costs for implementing these instructional materials reasonable?

Implementation costs for the CPE Project seem to consist chiefly of packaged materials, an occasional fraction of a teacher's salary when an alternative course seems necessary, material replacement costs and occasional increases in equipment, all of which are projected as "competitive," to quote the developers. Use of paper bound texts may require annual replacement.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The management/organization plan appears to be adequate. Teachers and professional consultants served on the development staff. The developers have provided an opportunity for the pilot teachers to make continuous evaluations and recommendations. However, the views of parent groups have not been solicited.

The extent to which NSF has monitored the project is not known to the panel. However, the Indiana Center is well known and has a very professional staff. It appears that the APSA's monitoring has been quite limited. In the future, in situations such as this, NSF should establish some guidelines relative to the responsibilities of the professional organization.

The project has contracted with National Evaluation Systems from Amherst, Massachusetts, to evaluate the course. The tests appear to be professional but we have not seen the results. We reviewed copies of all units of both semester courses, teacher and student materials, the skill kit, a copy of the original and latest update of the proposal, two written statements from the developers answering questions for this evaluation, and the achievement test. These materials seem to provide adequate information to both NSF and this panel.

Additional comment by Mrs. Kristine M. McGough

I am in receipt of the edited draft for Comparing Political Experiences and Human Behavior. Although I am in general agreement with many points of the final drafts, I feel too much of the sense of the panel has been lost in attempting to handle this by mail - I feel the entire panel should be reassembled so that we may have an opportunity to discuss it and take a vote as we did on Exploring Human Nature.

In regard to Comparing Political Experiences, I firmly believe that if this project was federally funded to replace traditional government courses - which appears to be the developer's intent - the burden should be on the developer, not the teacher, to insert material dealing with the Constitutional system of the United States.

The Human Behavior draft has suffered the most by the long distance review. The line "Ethical consideration is critical and should be closely adhered to if the goals are to be achieved" is vital to this report and was, to the best of my knowledge, agreed upon by the full panel - I cannot subscribe to the suggestion that it become some sort of "minority footnote."

What has happened to Dr. Tobach's report of 12/11?* Dr. Tobach's impressive professional credentials make her input particularly pertinent to Exploring Human Nature and Human Behavior. Her 5 page statement does not seem to be reflected adequately in the final draft. Dr. Tobach made strong recommendations concerning the development and teaching of all courses in the behavioral sciences.

* NSF Staff Note: The final, typed response from Dr. Tobach had not been received when this letter was written. The response is now included in Dr. Tobach's statement on Question 10 (on EHN and HB) and her statement on Exploring Human Nature.

I am personally uncomfortable with the reports on Comparing Political Experiences and Human Behavior. Given the time pressure and lack of material, I feel the panel reports of Exploring Human Nature was a fairly good representation of the panel's feeling - I am not as certain that the other reports are.

I feel our responsibility as a panel is a serious one and a final report done without sufficient time for give-and-take and mutual learning does not seem to really fulfill it.

Comments by Dr. Ethel Tobach:

1) Please change "man's" to "human."
2) I find the situations described in the test manuals extremely distorted, frequently pitting women and Blacks in biased opposition to each other.

(Above footnotes refer to items on pages 367 and 370 respectively.)

D. 15. d: CPE (Panel 3): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

Panelist: Dr. Douglas Alder

My personal reaction is that CPE is an outstanding curriculum project with a few shortcomings. The concept of using the school as a political laboratory is exciting. The developers have been careful to implement that idea in a feasible manner so that it can be implemented without causing a community blowup. The use of tape recordings is helpful for those students who are not good readers.

The "Busing in Boston" case is a bit weak. People from Boston felt it was inaccurate. I fear that the Daley Case is biased and that the ERA case is, too. Though I realize that these cases are not intended as thorough histories of these situations, I still feel that some more information should be included to balance the cases. The skills training materials are strong. The idea of training people in such roles as advocates, leaders, facilitators, supporters is realistic and can help students realize that there is room for them in the political arena and that that arena is not only in government.

I worry about the relationship between the American Political Science Association and the Indiana Curriculum Center. It seems to have been welded to obtain the funding but to me it seems unrealistic to think that a major scholarly organization would endorse a curriculum. They don't endorse books or articles (even if they publish them in their journal). I don't see why APSA should endorse a curriculum. There will likely be so much disagreement among scholars empaneled to evaluate it that they will likely never agree. Had the project been organized differently to include close monitoring by the Association at each step then I would not object, but that did not happen. Now the Association holds the copyright and finds itself responsible for curriculum materials. This is unfortunate in my estimation. The staff at the Center is more competent than a panel of political scientists and I surely hope the project doesn't falter in this organizational malfunction.

It is my opinion that such materials as these would never emerge from any support a commercial publisher might offer as modest research and development support. Therefore I think that the tax dollars devoted to this project have been well invested. This project began as a risky but novel idea that few publishers would have been receptive to. It has emerged as a balanced curriculum that may well be a major step forward in Citizenship Education. Without question it will be published. It will get considerable dissemination in my opinion and I think it will benefit students more than existing published materials. Therefore I think NSF has legitimately supported something that will benefit the nation. I am aware that the project will not go uncriticized. Some organized political groups may

attack it. I have listened to criticisms in detailed outline leveled by one of our group (and I assumed filed in his #10 response) and have come away unconvinced. I am not a recipient or applicant for NSF funding and so am not trying to protect that establishment. But I think this project is the strongest of the three we evaluated and is going to be a national benefit.

Panelist: Dr. Robert Angell

In my opinion these materials have real potential but they need to be worked over carefully. The idea of providing an alternative to the traditional political science course is a sound one and the inclusion of politics as practiced in other institutions than government is in keeping with present university trends. There is a large market for such materials and the reasonable cost of these when published should make them popular.

The problem (mentioned in the panel critique) of possible student misunderstanding of the purpose of the cases that illustrate concepts must be met by the developers. It is not an easy problem to solve, when there is not time to apply a whole battery of political concepts to each case. It might be possible to illustrate all the concepts first by reference to school situations and then present a few well rounded cases from the society which the students would then be asked to analyze with the help of the concepts.

I also believe that less fictional material (like the discussions of students about busing in Boston) and more evidence drawn from life (sound tapes of confrontations, minutes of school board meetings, etc.) would give greater reality to the situations treated.

Panelist: Mrs. Alethea Campbell

No comments submitted.

Panelist: Dr. George W. Carey

1. Much of the material cannot claim to be scientific by any stretch of the imagination. Many of the conversations or "dialogues" between students are fictitious. As such they cannot be said to represent the concerns, values, or attitudes of real life participants. Much of this could be overcome by actually interviewing participants involved in certain of the situations depicted in these materials but this would call for methodological sophistication which seems entirely foreign to the procedures used in the development of these materials.

2. Much of the material is clearly biased and value laden. Two blatant examples involve their treatment of Mayor Daley and ERA. There is no pretense of providing any balance even in those cases where careful political studies cast doubt upon the presumptions of the project directors (e.g., the work of Edward Banfield and James Q. Wilson concerning "political machines").

3. One could well question the need for the use of an "approach" like this, even if well done. The failure of the secondary schools with respect to political science education, as poll after poll has shown, is to impart to the student the very basic information he should have about our institutions and processes--the structure and procedures of the two houses of Congress, something of the history of the development of our institutions, the organization and procedures of political parties, the constitutional powers of the presidency, the role of the Supreme Court, etc.

4. While the project design laments the conditions at the secondary level with respect to civic education, the materials produced do not, in my judgment, hold out any prospect for the alleviation of these difficulties. In fact, there is every reason to believe, given their shallow and prejudiced nature, that they will, if widely adopted, exacerbate the situation.

Additional general comments:

I should like the following remarks included in the official report. They pertain to Panel 3 and the social science projects funded by NSF.

(A) Our initial group decision regarding procedure was a logical one given the circumstances: namely, five days to examine with thoroughness three major projects in the social science area, having to draft responses to nine general questions and sub-questions, and finally, having to draft responses to these questions in smaller subcommittees. Even though our procedures were reasonable ones, we did not have the time to complete our task. Our discussions in both the smaller committees and the group never were able to turn themselves very far from the questions that were put to us by NSF. The ten questions, in turn, overlapped and in many cases were redundant.

(B) Not all materials were available to us. In some cases, materials were available only in limited quantity which caused problems. This was true in varying degrees with all three projects under review, most so with respect to Exploring Human Nature (EHN) and Human Behavior (HB). In my judgement, this was a very serious shortcoming with respect to EHN, certainly the most controversial of these projects.

(C) With respect to the programs under review, one of the major questions that arose continually concerned need; that is, whether a need existed at the secondary level for courses built along the lines set forth in these programs. In this respect the following should be noted:

1) We were more or less forced to take the word of the project initiators relative to need. There was no way for to determine need.

What is clear, however, is that need, as set forth in the proposals, was in large part confused with the presumed novelty of the approach. More exactly, in all proposals much was made of the fact that the existing high school social science curricula did not utilize the approaches outlined in the proposals.

While this is undoubtedly true in all cases, such a state of affairs simply does not constitute evidence of need. There are countless approaches to the study of man which are not utilized at the secondary level but from this it does not follow that the secondary curricula are deficient and in need of revamping.

2) Where need was shown in justification of one program through citation to surveys which reveal an alarming ignorance on the part of large percentages of the population concerning our basic constitutional system, the project itself was not directed to the alleviation of the deficiency. Quite the contrary. The CPE program expressly states that its chief value is its lack of emphasis on the formal institutions and processes of our government. In this sense, the whole project is an anomaly. Part of its justification rests on the political ignorance of the American people with respect to formal institutions, yet its thrust in no way would serve to rectify this condition. It would, in fact, make the situation worse if its program were implemented at the secondary level.

3) While need cannot be accurately assessed, there are bits of information that throw some light on the matter. For example, the EHN project, after the expenditure of 2.5 million, has only "interested" one publisher, the same one which published MACOS. One would think that, if there was a real need, a number of commercial publishers might express serious interest. Moreover, the CPE project is hardly revolutionary and the materials which it offers, although highly biased, are far from original in approach and could easily be duplicated by any number of commercial publishers at a fraction of the cost. Indeed, at the college level, such materials have been produced, albeit in more sophisticated form. This fact tends to undercut the claim of need.

(D) The CPE project by all evidences is fairly far along (more than 1.2 million expended to date) and the fact is that no adequate appraisal of its output has yet been made. This is, in my judgement, a very serious shortcoming. There is need for a review by disinterested political scientists, i.e., political scientists not connected with the project in any way, past or present.

(E) The ten question format designed by NSF simply precluded panel consideration of certain basic matters such as those I have mentioned. Those who read the committee report should at least be apprised of this fact.

Panelist: Mr. Coe Dexter

The Comparing Political Experiences program will offer schools an alternative to the traditional structural-institutional approach to teaching civics education. While some program components, as discussed in the panel report, need strengthening and improvement, I believe that the program will prove to be of value to those students exposed to it.

It is my belief that students who might take this program should do so after studying basic courses in general constitutional theory and political practice. Also, students who use the materials, as well as teachers, school administrators, and community groups, should be fully aware of the fact that a major goal of this program is to teach political action skills. Schools should not adopt a program which is designed to teach such skills and later be dismayed when these skills are used in real life situations. This program has been designed to teach people how to function in a political arena, and should be considered for adoption on that basis.

I recommend that the National Science Foundation develop a series of guidelines concerning the roles of professional organizations which sponsor funded curriculum projects.

Panelist: Mr. David Engstrom

No comments submitted.

Panelist: Mrs. Verna S. Fancett

The program is unique especially as it deals with "political experiences" on a much broader base than other programs that attempt to develop the concept, government. In addition, it is designed for the active involvement of students in an arena with which they are familiar and which is a part of their everyday life--the school. In both ways the developers have attempted to give teachers and students what they have been hoping for over many years, and they are to be commended.

Because the program does not focus on the traditional organization and functioning of government in the strictly political, local state and national sense that we are accustomed to, there is a question about using the program as a substitute for a course in government. In such cases, the program would be a valuable companion or extension to the traditional course.

Teachers and schools who choose to adopt this program should be supportive of activities that encourage students to examine how their school operates and why it operates as it does.

Panelist: Dr. John C. Linehan

In general, I found the CPE project educationally sound. The concept that encourages students to participate and "learn by doing" is excellent.

The authors' methods used to encourage updating and continued relevance of the material will increase its appeal and value for years.

The competitive prices of the materials, plus adaptability to present teacher training, will increase its marketability.

The reading (vocabulary) level throughout this project will make it attractive and "readable" in most classes of the average high school.

It is a refreshing format that should increase the knowledge and skills needed by current high school students.

Panelist: Mrs. Kristine McGough

From a panelist's viewpoint, my impressions of CPE are mixed. I endorse the mode of "learning by doing" although I feel some of the content is a bit superficial - many of the recommendations for improvement appear in the general panel report so I will not repeat them.

In my role as a parent, I am bothered by the attempt to teach "moral reasoning" through the use of moral dilemmas. One of the cases, Ms. Jones, does not appear to be a choice between two equally justified actions, according to my value system, and I would not want my children told that it was. The developer seems to know this is controversial and talks about changing the "label" and also about not involving parents in review of the course for fear it will create "problems." I find this attitude offensive to me - particularly since my tax dollars were used to develop this course.

Sans moral reasoning, my general reaction to the course is favorable, although I feel it could use an increase in activity re partisan politics - voter registration, canvassing, party organization. This, of course, would have to be done carefully so that the skills of regular party work could be taught without leading the student into advocacy of a particular cause or political philosophy.

Would I permit my child to take this course? Yes, under certain circumstances. The assumption seems to be made that this would be for 12th graders who would presumably have a good background in history and government. This assumption is not necessarily valid in modern education. Due to the flexibility of many high schools, students can often defer their required history course until grade 12 and many systems do not require U.S. government. I would like to see CPE offered as an addition to the high school curriculum - not as a substitute for traditional government classes.

Additional general remarks:

I am basically in opposition to federal involvement in curriculum areas - by its very nature it tends to remove control of education from the local community. By the time the community has a voice in deciding whether or not to adopt a given curriculum, many millions of public tax dollars have already been spent.

As a layman, it was startling to read of the elaborate diffusion projects involving NSF curricula. Although there is much talk of "needs assessment" in the grant proposals, the diffusion projects seem to contradict this. At the risk of sounding like the little boy in "The Emperor's New Clothes" who is pointing out the obvious -- if there was such a great national need for some of these curricula, why does the government have to spend tax dollars to "sell" them to the citizens? In the case of some curricula I've seen, we could be in the position of financing the man who is selling us the snake oil. As a parent I was shocked to see the lack of parental input at the proposal stage.

Since I realize that there may be instances in which the resources of the Federal Government may be useful in the development of certain curricula, I wonder if this might not be handled better by funds to the states with close monitoring by NSF and a legal requirement for citizen involvement during the development stage. Also, since many federal projects are experimental in nature, I see no way that proper needs assessment can be carried out without involving parents. Since it is our tax money and our children who are used, it seems to me we should have a voice in deciding whether we "need" a particular program.

Panelist: Dr. Michael K. O'Leary

There is an important and continuing role to be played by NSF in supporting innovative social science materials that are sorely needed in American education. However, projects such as EHN, CPE, and HB should be funded only on the basis of documented needs, supported by evidence systematically gathered from social science teachers and local community representatives.

In funding proposals and in monitoring development, NSF should concern itself with the market for the materials produced. This entails satisfying the criteria of (1) meeting identified needs, (2) flexibility of educational uses, (3) low cost, (4) quality of the materials and (5) avoiding widespread rejection by teachers, administrators and the communities in which the materials will be used.

Projects funded by NSF should pay equal attention to the development of both the teacher and the student materials. Teachers' guides should be developed which minimize the need for specialized, costly in-service training and which enable teachers to implement the program adequately, even if they are not specialists in the discipline being covered.

Panelist: Ms. Juliana Podraza

The CPE project is a refreshing program for students studying government and politics. The developers have documented a need, presented a clear rationale and stated a position of continued evaluation of the project.

The curriculum emphasis and development of materials are centered on practical issues that not only will hold the interest of the students but also be of benefit to them in the future when they will be directly involved in domestic politics. Many teachers desiring a program that actively involves the students will find it in this CPE program.

In general, the CPE program appears to be a fine alternate to the traditional approach to the study of American Government and Politics.

Panelist: Dr. Ethel Tobach

I do not feel qualified to evaluate the substantive and educational aspects of this program. As a citizen who believes that scientists have a special responsibility to be accountable to society, I find this program fails to accomplish its goal, i.e., "the preparation of young people to become competent political actors." Although it would be a controversial program, I think high school students, together with their teachers and parents, should work collaboratively to solve their institutionalized school problems in activities with their local, state and federal legislatures, executives and agencies.

1) Additional comment by Mrs. Kristine McGough:
"I am concerned about the ethics of student participation in experimentation."

D. 16. a: TPE: NSF Descriptive Information

PROJECT TITLE: Technology-People-Environment (TPE)

PROGRAM: Science Curriculum Development

PROJECT DIRECTORS: John G. Truxal
E. J. Piel

INSTITUTION: State University of New York at Stony Brook

DEPARTMENT: College of Engineering

BUDGET: Total Granted: $262,400

Dates: 7/1/74 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: The project will develop a non-textbook, activity-oriented, ~~multi~~disciplinary approach to science, incorporating concepts from mathematics, language arts, social sciences and technology for the benefit of secondary school students who have been academically unsuccessful.

PROJECT SUMMARY

OBJECTIVES

Project Goals. In seeking to promote technological as well as scientific literacy among the secondary school students of the nation, the National Science Foundation supported the work of the Engineering Concepts Curriculum Project (ECCP) in developing a course, "The Man-Made World". (TMMW), aimed at the average college-bound student who is not likely to become a science or engineering major. One realization that became evident as TMMW started taking hold was that many of the concepts it covered would be of value to students who, for any of a variety of reasons, were not capable of handling the level of the material that had been developed.

With this idea in mind, Dr. Truxal in developing an alternative approach to developing technological literacy among "non-academic" students. As described in the proposal, the materials will involve students in an "activities approach" and will be written for the student who has less-than-average reading, writing, and mathematical skills.

At the same time, there is the realization that the "non-academic" student, especially in urban and inner-city areas, is likely to have a very poor attendance record. For this reason, the activities to be developed are short--usually of only one day's duration--so the student who attends

sporadically will have an opportunity to complete the activities being explored on the days he does attend. Two benefits are expected to obtain from this approach: (1) the exposure the student does get will make sense from both a practical and a technological point of view--thus enhancing technological literacy, and (2) the practicability (to the student) of many of the activities will arouse the interest of some poor attendees, hopefully improving attendance records.

The goal of the end of the twenty-four month project is a set of packages of activity-oriented materials, available in two alternative forms and with accompanying low technology materials.

(1) For senior high school students, a set of eight mini-courses. Each mini-course will consist of a set of one- and two-day activity packages containing text material, student sheets, teacher's manual, appropriate film loops and audio or audio-visual materials, and instructions for student experiments or games using readily available, low-cost materials. This multi-media content is described with examples in more detail in the later sections of this proposal.

(2) A set of one-hundred and fifty one-day activities, some of which will be developed from the above mini-courses, directed at junior high school students and designed to be grouped into one- and two-week units.

The large number of one-day activities will be grouped in related sets so that they can be used as units over a period longer than one day. They are designed as one-day activities -- a characteristic which is of primary importance for classes in which average attendance is below 50%, and relatively few students are present two consecutive days. These activities will be designed to motivate the students with minimum reading skills and mathematical background.

ACTIVITY PLAN

During the time since Foundation funds were first made available to the project, the timetable contained in the original proposal has been followed quite well. The pilot materials were put into shape for field trials in schools not previously involved with the materials. Final revision of the first four of the originally-planned eight minicourses is now nearing completion. In addition, a publisher, Youth Education, Inc., has been selected (with Foundation approval) and contract negotiations are now underway.

During the second year of activity - the period covered by the present recommendation - the remaining four minicourses will be revised and prepared for publication. In addition, project staff now plans to develop two additional minicourses during the period to increase the flexibility of the curriculum. Finally, a student evaluation package for the entire program will be completed.

ORGANIZATION AND MANAGEMENT:

While this is an entirely new project, it plans to build its staff initially around individuals who have played focal roles in the Engineering Concepts Curriculum Project. Indeed, the proposed project is derived from experiences accumulated from the ECCP work with secondary schools.

HISTORY AND RELATED PROJECTS:

The Technology--People--Environment project had its beginning in 1971-72 when the staff of the Engineering Concepts Curriculum Project (ECCP) started to develop, in a pilot-test form, one- and two-day activities aimed at "non-academic" students. These activities were envisioned as being similar in overall content to the course "The Man-Made World," developed by ECCP. The "activities" approach was selected as being more appropriate to students who have less-than-average reading, writing and mathematical skills; the short duration of the activities was employed as a method of instilling a sense of achievement (finishing what was stared) in students with very poor attendance records.

In addition to additional minicourses projected for the second year of the project, an evaluation package for the entire program is being developed.

Accomplishments to Date: (September, 1975)

The first four mini-courses are currently in press. In 1976, six more mini-courses will be completed providing sufficient activities for a year long course of instruction. The publisher is Learning Realities, Inc., New York.

PERSONNEL:

The Project Directors are Dean John G. Truxal, College of Engineering, SUNY at Stony Brook; Dr. E.J. Piel, Director, ECCP Project, SUNY at Stony Brook; and Project Manager, Dr. Thomas T. Liao, College of Engineering, SUNY at Stony Brook.

D. 16. b: TPE (Panel 4): Project Director's Response to 10 Review Questions

Question 1: Is there a genuine need for these instructional materials?

A. During the period of 1968-70 while The Man-Man World materials were being tried and revised and explained to secondary school teachers, students, administrators, and science education specialists at the University level, the project personnel were encouraged to look into the possibility of producing similar materials which had a lower reading level and consisted of one day classroom activities. At NSTA (National Science Teachers Association) Conventions, NSF and McGraw-Hill supported workshops and instituted as well as ASCD (Association for Supervision and Curriculum Development) and NASSP (National Association of Secondary School Principals) meetings, from 1970, until the present, the ECCP staff has solicited information from teachers, students, administrators, and science education specialists regarding their perceptions of needs for materials and approaches which would attempt to provide technological literacy for students who are not planning to attend college as well as those who were. For example, in 1970 the ECCP Executive Director and Associate Director attended the National Convention of the National Association of Secondary School Principals for the express purpose of presenting typical experimental activites from the TPE (at that time called "Activities Approach to the Man-Made World") to obtain reactions regarding the need for such materials, and feedback on the appropriateness of those which were presented. That same year the preliminary materials were presented to two hundred Junior High School Science teachers at an Edison Foundation sponsored program at the University of Richmond in Richmond, Va. Favorable reaction and valuable suggestions encouraged the ECCP staff to look further into the possibility of such a program. A series of exploratory meetings was also held with ECCP trained inner city teachers who recommended an activity-centered, multi-media based instructional program.

B. Science Educators such as Paul DeHart Hurd and James Rutherford, as well as authors such as Alvin Toffler (Future Shock) and Ralph Nader were recommending more activity centered materials for the development of technological and scientific literacy of non-scientist citizens as well as for the preparation of future scientists. Howard H. Cummings in Science and the Social Studies (Twenty-seventh Yearbook of the National Council for the Social Studies) said, "There is a need to study the role of Science and Technology in our life today as one of the important aspects of modern citizenship." In 1971, the American Association for the Advancement of Science and National Association of State Directore of Technological Education and Certification published "Guidelines and Standards for the Education of Secondary School Teachers of Science and Mathematics." Of the thirteen major topics of science and technology listed as

minimum science competencies (TABLE 1, page 16), three deal directly with the specific content of TPE. They are Modeling and Prediction (computer simulation-programming-optimization) and Control of Systems (feedback and stability) and Interaction of Society and Technology.

The ECCP staff knows of no other major effort to teach these concepts at the secondary school level.

C. The growth of this project is just beginning. The first commercially available materials were delivered to schools in September, 1975. Trial materials were used by approximately two hundred and fifty students in 1970-71 and 1971-72, five thousand in 1973-74 and twenty thousand in 1974-75. The commercial version is presently being used by approximately eight thousand students. Many of the schools where the final trial version was in use in 1974-75 were sufficiently satisfied with it to continue use during 1975-76 and plan to purchase the commercial version in 1976-77 when the eight mini-courses are all available. Market projections indicate potential use of at least one of the eight mini-courses by five hundred thousand students. This is possible because the mini-courses can fit into a number of different slots in the existing curriculum--science, mathematics, consumer education, social science, English, and industrial arts from grades 8 through 11.

D. While alternative materials are available for use in these various courses at the different grade levels, there are none which provide the interation of science, technology, and society as the base for their development.

The two basic needs which this program attempts to meet are:

1. The development of strategies for making it possible for previously unmotivated students to succeed in acquiring useful learning skills.

2. The development of a technologically literate public, who understands the nature, characteristics, limitations, and capabilities of modern technology and how this rapidly changing technology impacts on their lives.

Question 2: <u>Is there a market for these instructional materials?</u>

A. As indicated in our answer to part D of question 1, there are no other programs available at this time which attempt to develop technological literacy. There are some materials available which deal with small pieces of this picture, but none which could form the basis for, at least, two semesters of study as these do.

B. These materials have been specifically designed to answer the problems expressed by teachers and administrators during the needs assessment described in question one.

Some schools are looking for new one-semester interdisciplinary courses which speak to the questions of the interaction of technology and society, others are looking for full year courses, others are concerned with the mandate of "NO NEW COURSES" but want to update existing courses in science, social sciences, industrial arts, mathematics, etc., at little extra cost. The mini-courses which cost $40 for a package consisting of sound filmstrips, transparencies, approximately 20 student activities for up to 250 students, and teacher guides meet this need quite well. While adoption of these materials does not require reconceptualization of curricula plans, it fits quite well into new curricula patterns as well as into established ones.

C. The dissemination plan includes the need for awareness conferences for school decision makers. These included participation in multi-program conferences such as those supported by NSF in the Summer of 1975 at Stanford Univ. and the University of Colorado. Also included in this plan was the presentation of the content and approach at appropriate NSTA, NCTM, MCSS, and Industrial and Industrial Arts Conventions. Another part of the plan is the presentation of the materials at specifically designated workshops supported by the publisher and/or the National Science Foundation.

Implementation is enhanced through an opportunity for teachers to work with some of the activities of the mini-courses in which they are specifically concerned to get a "feel" for the approach, if they have never used an activity approach to teaching. For those teachers who plan to use activities related to the Analog Computer or Logic Circuit boards, additional time might be needed in order to become familiar with those two pieces of equipment. While we have had a number of teachers who have been extremely effective in using the materials without previous workshop experience, it is our opinion that since this course is not another course in a familiar discipline, but rather an interdisciplinary approach to teaching about the interaction of technology and society, that some specific teacher preparation is desirable.

D. The free market without an implementation program would be smaller than that projected in the answer to question 1 (C) above, and would develop more slowly. How much smaller or slower we cannot say at this time since the project and the publisher are presently attempting to get data in this area.

E. Market studies by both McGraw-Hill Book Company when they were being considered as a potential publisher, and the publisher, Learning Realities indicate a growing market for the entire set of mini-courses as well as individual packages. The publisher is committed to running workshops for teachers and administrators for both awareness and implementation. The materials will also be exhibited at selected national teachers conventions such as the NSTA Convention to be held March, 1976.

Question 3: Do these instructional materials possess a clear purpose and rationale?

A. Each mini-course has a statement of objectives and a rationale for the unit in the teacher guide. Each activity has a statement of general and specific objectives. The transparencies in each package are directly related to the mini-course objectives. The wall poster is used as a method of keeping the overall objectives in front of the students and teacher at all times. There are instructions in the teachers' guide for use with the poster and transparencies which focus on the objectives. The filmstrip in each mini-course is directed at the overall objectives as well as providing an effective media-based, motivational experience for beginning as well as summarizing the mini-course.

Pedagogical Assumptions

1. Students in non-academic tracks who are categorized as "slow learners", etc., are generally capable learners when motivated and they are given materials that do not exceed their reading and mathematical achievement levels. (We assume a 6th grade level.)

2. It is important to structure curriculum materials for these students so that regular attendance is not mandatory.

3. Educational material should be flexible. They must be designed to fit as many teaching and learning strategies as possible without stretching material beyond the boundaries of usefulness. This implies describing, at least, some approaches a teacher or a school system might find educationally useful.

4. People learn to solve problems, make decisions, or use mathematics by solving problems, making decisions and using mathematics, not by being told about it. Each activity in this program starts with a problem to be solved and then goes on to develop systems for solving that problem.

B. Technology is an important element in our society and decisions we make concerning its applications will affect our lives. (M-C I - Activities 1 & 2) There are some techniques for looking at classes of problems that are more productive than others. For example, a statistical view of the world. (M-C I - Activities 4, 4A & 5) (M-C IV - Activities 4, 6, 7, 11) Modeling concepts (M-C I - Activities 9-14) (M-C IV - Activities 4, 5, 7)

C. Yes, in the trial publication of Mini-Course I - VIII we asked the teacher to comment on the appropriateness of each activity as it related to stated objectives of the mini-course and the stated objectives of the activity. In general, the teachers' responses

indicated a strong relationship between activities and objectives. Those cases where responses were less than very good, the activities were redesigned and changed wherever necessary. These sets of activities are not the only way our objectives might have been reached, but the method presented here appears to be an effective approach based on the evaluation of the trial students and teachers. Alternative sets of assumptions, values and goals would define the problem differently and would presumably result in a set of materials that is different in at least some ways.

D. One of the criteria for considering an activity as completed was that the students and teachers in the test schools should find the materials clear and understandable. Our evaluation questionnaires were directed at specific activities and the M-Cs as a whole. If they objected to a section of an activity, the teachers manual, the filmstrips or the mini-course in general, we went back and changed it.

Our intention was to make the sequence of concepts clear to the teacher and the sequence of activities should be engaging to the student. The frequent change of topics is used to encourage a feeling of novelty in the content while having the conceptional frame of the activity provide the unifying element for both student and teacher. The continuing clarification of, and focusing on the concepts is a fundamental role of the teacher in the TPE program.

E. In general we encourage the use of the materials with a group of students using an activity simultaneously. This keeps the societal implications of the decision making tasks a part of the activity.

An individualized format is possible with the mini-courses and we provide outlines and instructions to aid the teacher in using the materials in this manner.

Question 4: Is the content of these instructional materials scientifically correct?

A. This question needs to be addressed from two quite different viewpoints. First, there is the basic yes-no question of accuracy statement-by-statement or concept-by-concept. To insure accuracy in this sense, the materials have been read by faculty members in both engineering and the related science (including sociology). There has been an insistent attempt to avoid the possibility the student learns facts or ideas which later have to be relearned differently. The fact that the materials have been developed over more than five years (the first three without federal funding) means that a large percentage of the materials have been re-worked and revised several times. Thus, while minor specific errors certainly may occur, we generally are confident of the scientific accuracy of the important concepts.

From a quite different viewpoint, and probably more important, the inferences students (and teachers) draw from the materials should be scientifically valid. Such inferences should not lead to scientifically incorrect ideas, to potentially dangerous behavior, or to an unfounded sense of confidence of mastery when the student actually has only introductory knowledge. While we have made a major effort to anticipate such adverse effects and we are reasonably confident we have avoided obvious dangers, we also recognize that many of the topics treated are exceedingly complex. In many cases, there is no simple, correct solution; simplistic approaches are what we try to avoid. We believe we have achieved some success in this direction, but we recognize this as a very difficult question. The Teachers' Guide constantly warns teachers of this danger (i.e., Activity 5 - Strategy & Extension).

B. We treat a variety of problems of current national importance (e.g., auto safety, and energy throughout mini-courses 1-4) and also try to teach techniques of modelling and analysis which dominate modern systems engineering. The T-P-E material borrows a great deal of material from The Man-Made World text, which in 1971 received the Lanchester Prize of the Operations Research Society of America as the best technical publication of the year in that field in competition with the research publications. The feedback from college engineering educators on the currency and technical quality of the material has uniformly been excellent.

C. The primary target of T-P-E has been the underachieving high school student who is typically in the non-academic track. Thus, we are hoping to start education in technological literacy for these students. In addition, we hope to interest a portion of the students in moving toward an academic track and even seeking careers in technology.

Thus, we are not training future research scientists, but we do hope to attract young people to participate in the scientific research-development test-evaluation enterprise.

For both these directions, one goal of T-P-E is to motivate and complement the regular mathematics and science offerings in the schools. When T-P-E materials are used in the junior high or middle schools, they represent enrichment materials for the academic students and, hopefully, motivation toward science careers.

D. The most accurate description of the discipline covered by these materials is "information systems engineering." If one divides engineering (i.e., the use of science in real-world problems) into two parts (systems and materials), T-P-E is based on the systems portion. In this focus, the educational materials cover topics in applied mathematics and the physical sciences, primarily. Since the discussions also involve social problems, and Mini-course 6 emphasizes communications the program also touches on Social Science and Language Arts.

Question 5: Is the content of these instructional materials educationally sound?

A. In general the reaction of teachers, students and parents has been very positive. There has been some concern expressed that the course does not prepare students to take the "College·Board" exams. This was not intended to be a focus of the materials, although decision making skills and confidence in these skills would probably help the student. Some teachers were concerned that there are too many paper and pencil activites. There is some merit to this concern. If the only thing done in the class was the activity sheets without pursuing some of the activities suggested as extensions or following a local problem such as solid waste disposal, real estate development, election practice, zoning decisions, etc., the course could get dull but our instructions to the teachers are consistently urging them to get into some local problem. It was determined that without application of these concepts to something the students see as a real problem (after an introduction via activity sheets) there was little learning taking place. Another reason is that cost was seen as a real constraint on implementation. Extensive, expensive equipment packages, if made required, would probably make the materials inaccessible to the type of schools that the greater portion of our anticipated audience attends.

The teachers in the trial schools have sent back very favorable reactions on the appropriateness and effectiveness of the materials through our formal feedback instruments and meetings with them.

B. At this point there is little to indicate any serious unresolved student difficulties caused by the materials. The total approach of simple activity based introduction to these pervasive concepts with considerable support for teachers to help bring the problems of their communities into the classroom for education, while keeping the achievement levels of the students in mind is in itself an ingenious, effective learning system.

C. The conceptual material can be handled effectively on many levels. The audience has been defined for this material and for them it appears to be very appropriate. TPE used in conjunction with TMMW seems to be an effective way to reach heterogenous classes of eleventh and twelfth grade students.

D. The "Quality of Life" mini-course which is presently being revised is based on the idea that the Quality of Life which a person perceives is a function of his individual values as they come in contact with societal values.

The mini-course is designed to involve students further into the study of how individual values and group values come into play when decisions are made about the quality of life.

Through a series of activities in which the students individually list their like and dislikes and individually rank them in a priority list there is a class discussion of things which some people like and others dislike. Students compare their own likes and dislikes against those which are discussed. They do not hand these lists in to the teacher. Given a list of potential areas of local, state and federal spending they list their own priorities in spending. Clearing up pollution, improved schools, combatting organized crime, street crime, building highways, etc., are on such a list. This is discussed in class but is also not turned in to the teacher.

E. A basic TPE premise is that during the high school years and especially later as adults, students will be called upon to make decisions in our society which involve some aspect of technology. These decisions will, of necessity, involve technology, society and themselves as individuals. The interaction of these three provinces produce very complex, frequently conflicting information sets which make decisions difficult to arrive at. It is necessary that an individual have some generalizable methods of viewing the interrelated, dynamic systems we call society, if the decisions arrived at are to be valid.

The ECCP has attempted to deal with this set of ideas with secondary school students in two ways, the first was The Man-Made World (1971) and the other Technology - People - Environment.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

A. The project staff, author consultants, and implementation project directors anticipated a number of impacts of the instructional machine.

First, we anticipated that the teachers and students would be enthusiastic about the use of one day activities which did not rely specifically on the work of the previous day, but which did fit into a coherent package. We also anticipated that their teaching pattern in all courses would change.

Next, we anticipated that while interested in the approach to the education of the target population school districts would question the expenditure of money for Analog Computers and Logic Circuit Boards for this same student population. We also anticipated that they would be impressed by the student achievement during the study of these materials.

B. Feedback obtained from 100 teachers and 5000 students during the trial version has indicated to the project directors that these two anticipated impacts were made. Students did learn to question dogmatic statements, they did learn how to examine criteria and constraints prior to making decisions, and they did examine desirable as well as

undesirable effects of specific technological devices and systems on the individual and society.

Teachers who have been involved in the program report that their approach to teaching all of their courses has changed as a result of being involved in this program. Through the activities which require family involvement such as the "No Television?" "How did you Live?" activity in Mini-course IV, parents have been able to participate in looking at systems for decision making related to the conservation of energy in the home. Some school districts have reported a decided increase in student enrollment in this course the second year. A number of administrators have expressed genuine surprise at the ability of the students to use the equipment of the program in a positive manner and with the potential use of the same equipment in other courses in the Science and Industrial Arts area in the school.

C. Some unintended effects which we have noted have been very encouraging. In some inner-city schools where these materials were used as a complete course there has been a marked increase in the percentage of students who were present every day. One of the reasons for developing the one day activities was that in many schools students have erratic attendance patterns. Some teachers report that they can only expect half of the students enrolled to be present on any one day, and that courses which require that today's lesson be a continuation of yesterday's and a prerequisite for tomorrow's left many students confused and discouraged. In order to alleviate that problem these activities were designed to be accomplished in one school period. Teachers report that as a result of this planning the students have been able to feel a sense of accomplishment as a result of having been in class that one day. A direct result of this has been a marked increase in attendance in class. One teacher reported that students were sneaking into school for his TPE class and sneaking out again. School administrators have reported a marked improvement in the morale of some of the teachers who teach this course and attribute this directly to the success they feel with students who have previously been unsuccessful.

D. The project staff has made a conscious and continuing effort to make the materials fair to all students and teachers. There is one staff member who has been assigned the specific task of eliminating all unfair statements, pictures, etc., from the material. The general approach to each activity is to have the teacher present the problem in an unbiased way, and to have the students work in pairs to complete the activity. The evaluation of student progress depends not only on teacher administered tests, but also on student self-evaluation. See pages 51 and 52 of Teachers Guide for Mini-course I - "People and Technology."

E: The important process features of these instructional materials are that throughout the eight mini-courses the students are asked to make decisions. Some of these decisions are in simulated situations such as Activity 3 of Mini-course I - "Design With a Purpose." Others are in real situations such as Activity 10 of the same mini-course "Gasoline Mileage and Decision Making."

Another process is that of group discussion and group decision making; modeling of real systems through words, picture, graphs, and various pieces of equipment ranging from 8½" x 11" paper to design an airplane which meets specific criteria, to using an Analog Computer to simulate a lunar landing in its descent to the surface of the moon. Students learn to examine their own personal characteristics such as reaction time and ability to recognize patterns. Students are afforded the opportunity to work alone, in pairs, in small groups and in class groups as they proceed through the various activities of a mini-course.

Question 7: Do these instructional materials present implementation problems for the schools?

A. There are two abilities which teachers require in order to work successfuly with students using these materials.

First, they must be able to resist the temptation to lecture and give all the answers. They must encourage students to think through problems on their own or with their partners. They must be comfortable in a setting in which there is a large amount of student activity.

Second, in order to be effective in those activities which use the analog computer and logic circuit boards, they must have enough familiarity with those two pieces of equipment to allow students to use them. Both pieces of equipment are so designed that they cannot be damaged through incorrect wiring of circuits or power settings. They are also designed so as to be perfectly safe in all situations of anticipated student use other than actual disassembly which is virtually impossible in the normal classroom situation.

Many teachers already have the first ability described above--others can acquire it through practice following a short introductory period of work with the materials. Others will never develop this ability and should not be encouraged to teach using these materials.

The second ability is possessed by a smaller fraction of the teaching population, but can be learned through experiences following a short implementation workshop. Since the equipment is virtually trouble free there is no need for training in equipment repair. AMF, the company which manufactures the equipment has a policy of a one year warranty which guarantees free repair and replacement, and a charge for parts only in subsequent years.

B. The materials pose no special problems for existing organizational structure, and actually are flexible enough to be used in almost any of the variety of structures from classrooms with desks fastened to the floor to open classrooms to open schools.

C. The cost of these instructional materials varies from forty dollars ($40) for a single mini-course of six to eight weeks for up to 200 students to thirteen hundred and twenty dollars ($1320) for the eight mini-courses plus the recommended instructional equipment.

It is the experience of the project directors that most school systems introduce the course during the first year by purchasing the mini-courses (only the trial materials costing $100 had been available until Sept. 1975) and a minimum of equipment. During the second year they have usually ordered the remainder of the necessary equipment. If as many as one hundred students are involved with six mini-courses and all of the equipment in a year, the cost would be $1240, or $12.40 per student. The second year, there would be no additional cost for another 100 students bringing the per pupil cost for the two years to $6.20. In subsequent years, the only additional costs would be six additional spirit master books at a total cost of $120 for each two hundred students. The cost then for 100 students/year for the first four years would be $1360 or $3.40 per pupil. One thousand dollars of this amount would be for the original permanent equipment.

D. The new instructional materials contain all the necessary learning resources as outlined above. The only additional resources might be magazines which the library would have purchased as a normal part of their service, and free or rented films and/or T.V. tapes as the teacher saw a need for them.

E. The new instructional materials do not require school districts to establish optional classes for those who do not wish to use the new material. The materials fit into existing courses at a variety of levels of age and ability. The values stated by the students in Activity 1, Mini-course I "Technology and You" are not to be graded--the students and teachers are both informed that there are no right or wrong answers, and the worksheet itself is retained by the student.

Question 8: Are the costs for implementing these instructional materials reasonable?

A. The expected total dollar costs for implementing these materials are: (Assuming 6 Mini-courses/year 100 students involved per school)

1) Materials for Learners

Expendable:

Ditto Masters $20/minicourse/200 students = $120

Non-Expendable:

Filmstrip, etc., $20/minicourse = 120

Equipment - Logic Circuit Boards = 1,000

Analog Computer

Noise Level Meters, etc.

2) Teacher Salaries are not included since these materials do not require additional staff.

3) Training Personnel - Teacher preparation programs for these materials can be organized through a school system operated in-service program such as that now in progress in Philadelphia, Pa. The operating costs for such a program for 10 teachers is $100/workshop meeting. Five such meetings would be sufficient for this program.

It is <u>vital</u> that the personnel operating such workshops be adequately prepared. This has been done in the past at NSF supported Resource Personnel Workshops at a cost of approximately $1000/person. This provides a multiplier effect which results in a cost of $110/teacher for the first 10 teachers prepared. This cost goes down for subsequent workshops by the same leader. Area in-service programs which attract teachers from a number of schools would cost a bit more because of added cost for transportation and administration.

B. Refill needs are $20/mini-course/200 students or $0.10 per student/mini-course.

C. The needs which this course meets are not usually met by other "standard" courses in the curriculum. Activity type courses probably meet some of the needs of development of student skills, but there are none of which the project staff is aware which meet the need to develop technological literacy.

D. Comparable instructional materials developed by Learning Realites cost approximately the same. The project staff assumes that those produced by larger publishing companies would cost more since in our preliminary discussions with larger publishers we were told that the package which has been produced could not be sold for less than eighty to one hundred dollars.

E. The project sees no nonfiscal costs such as psychological or social. Actually, all the comments received from students, teachers, and administrators lead us to believe that there are very strong psychological and social benefits as a result of this program.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

A. Since these materials grew out of The Man-Made World project, the people involved in that program must also be considered as part of the TPE program. A total of both programs shows the following numbers of people involved in categories:

Industry Scientists and Engineers	12
University Scientists & Engineers	25
Secondary School Teachers	33
Secondary School Administrators	2
Students (Directly Involved)	3
Students in trial schools	5,000
Teachers in trial schools	100
Parents as they interacted with students	?

B. The internal monitoring procedures for the project include the reading of all material by at least three professional staff members and two consultants prior to publication. Also the checking of visuals and tapes by all members of the staff and teacher consultants prior to release. The evaluation program within the project was also monitored by the entire professional staff and the teacher consultants prior to use. In addition, the staff member who is responsible for evaluation is using the evaluation plan as part of his doctoral thesis at another University (NYU) thus assuring a thorough and independent review of the evaluation plan and materials.

C. The external evaluation procedures for the project are (in addition to those mentioned above) the use of a psychologist consultant from the University of Wisconsin and a Secondary Education Professor from Wichita State University. Dr. Ian Westbury of the Science Education Department of the University of Illinois is currently conducting an independently supported evaluation of the NSF supported Summer Teacher Preparation programs directly related to the TPE materials. While this evaluation is aimed at the teacher preparation aspects of the Summer programs, it is also providing an independent evaluation of how prospective teachers view the instructional materials themselves.

D. The project administration consists of a Director who is also Dean of Engineering and Applied Sciences at SUNY-Stony Brook, an Executive Director and Associate Director who are also professors in the College of Engineering and a Full time Staff Associate. Other personnel include an editorial writer who checks for biases as well as writing errors, an Administrative Assistant and part time students who type and perform clerical tasks.

E. The project staff sends periodic reports to NSF and provides a Newsletter for interested parties. In addition, the staff is in frequent phone communication with both the Course Development and Implementation Sections of the Foundation.

Both trial and finished materials are forwarded to the Education Directorate of NSF as soon as they are available.

D. 16. c: TPE (Panel 4): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The project's needs assessment draws mainly from the author's experience with the implementation of The Man Made World which led teachers to ask for a more activity-oriented product usable by students less academically able. These teachers supported the original contention of the ECCP project that present science courses contained several serious problems: particularly lack of student interest, expense, relevance and a poor attitude of the general population toward science. The needs assessment in the proposal is largely an argument for courses supporting technological literacy. Documentation from other courses or survey results is used to support this stated need.

Although not cited in the proposal, the need for technological literacy and the understanding of how science, society and technology interact appears to be well documented and supported by a wide range of individuals and groups. With the exception of a unit on technology in Ideas and Investigations -- Science: Physical Science (a course designed for non-academic students in grades 8 - 12 published by Prentice-Hall) no other materials are available in the area of technology for students of this ability. The lack of materials for the academically less able student in general, and specifically in the area of technological literacy, argues strongly for NSF support of the TPE and similar projects. Because publishers are reluctant to risk research and development money, federal support for new and non-traditional science curricula is necessary.

Based on the design of the TPE materials (reading level, mathematics requirements, and the format of short independent activities) and the pilot experience of the project, these materials have the potential of meeting the need projected by its proposal. The panel estimates that these materials could reach approximately 50% of the students enrolled in grades 9 through 12. The project's experience indicates that a smaller percentage of students having an average or higher ability in grade 8 are also potential users. This is a change from the originally proposed target group. This point will be elaborated in question 9.

Question 2: Is there a market for these instructional materials?

There are few if any examples of other materials available in the schools to meet the need in the area of technology, people, and environment. This course makes a unique attempt to educate children for successful coping with the problems of living in a technological society. The project makes use of mini-courses on special topics.

The course is not designed to fit into a pre-determined and existing slot in the secondary level. Such slots do not exist, either in the science curriculum itself or in the total curriculum, including all the disciplines typically found at the secondary level. Instead,

the course is planned to substitute for presently existing courses, such as general science, physical science, or in some cases general mathematics.

In addition, the mini-course format will provide opportunities for teachers and schools to select appropriate topics for insertion into existing courses or as supplementary resource materials.

Dissemination of materials and philosophy of the course is minimally treated, both in the original proposal and in the procedures used to date. According to the available information, teachers and school administrators have been apprised of the availability of these materials through presentations at national, regional, and local conventions of science teachers. In addition, a newsletter with a mailing list of 5,000 teachers and other interested persons has been used to give information about the progress of the project.

Although plans have not been formulated at present, this panel recommends that the publishers of these materials be encouraged to set aside monies for implementation purposes and dissemination of materials. These monies should be used for teacher institutes, in-service workshops and awareness conferences for general dissemination of information on the course.

Many teachers need in-service opportunities of a general nature to support an activity centered approach to low ability students before being assigned to teach TPE. In addition, the unique nature of TPE requires training specifically in the content of the course materials. It should be noted that education in technological literacy is not just a minor variation to the present science curriculum. Teachers' backgrounds and experience in science do not necessarily prepare them to teach TPE.

Market surveys by one or more textbook publishers have indicated a large potential market at the level and for the special groups for which the materials have been designed. Educators appear to be receptive to these materials as potentially usable resources in classes in science and mathematics. The technology - people - environment base of these materials seems to fill a need rapidly becoming more evident to school personnel. It is probable that the course will find a substantial market in the secondary schools.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The explicit statements in proposals, teachers' guides, and associated promotional literature make it quite clear that TPE is intended to teach the fundamental concepts relating to living in a technological society. Twelve concepts underlie the course and, in varying degree, permeate all sections of the course. The concepts are:

(A) Decision-Making
(B) Descriptive Modeling
(C) Functional Modeling
(D) Criteria
(E) Constraints
(F) Optimization with Algorithms
(G) Optimization with trade-offs
(H) Interaction of Sub-Systems
(I) Feedback
(J) Stability
(K) Control of Systems
(L) Synergy

The centrality of these concepts to the course is apparent from our reading of the instructional materials, but, without seeing the results of thorough classroom evaluation we cannot be sure of the extent to which students are able to infer the assumptions, values, and goals from their contact with the course.

The TPE course does not aim to teach basic scientific principles directly, but the content of the units can provide frequent opportunities for teachers to direct the students' attention to laws of nature, properties of matter, and the behavior of living things.

The panel sampled certain units in the mini-courses in detail and found them clearly presented, suitably graded in increasing order of complexity, and yet apparently as independent and self-contained as the stated objectives of the course would require them to be.

The panel found that almost every unit of the TPE course couples strongly with contemporary American life, mostly urban, and that the activities of the course could have some very direct practical benefits in equipping students to cope better with their everyday environment. Members were concerned that the very timeliness and currency of all examples and illustrations may render sections of the course rapidly obsolescent. As would be expected in a course dealing with technology and society--the most swiftly changing aspects of life in America today--there is an ephemeral quality to the material. More than almost any other curriculum project, this particular one would seem to be in need of advance planning for frequent and periodic updating. Otherwise, this will prove to be a one-shot curriculum improvement program with a very short expected half-life.

The panel liked what it saw of the experiential approach taken by the course, and applauds the efforts of the project managers with this approach. Their reported anecdotal feedback from students suggests that pencil-and-paper and show-and-tell approaches are not as productive in maintaining interest and motivation.

Finally, the panel observed that many parts of the TPE course are deeply infused with social and, indeed, ethical values. It is

proper and desirable for students to be concerned with value-laden issues and to learn to make judgments regarding them. It is improper to indoctrinate students even by careless use of stereotypes such as "Madison Avenue." Materials should be read skeptically with this in mind and corrected accordingly.

Question 4: I. the content of these instructional materials scientifically correct?

On the basis of a random selection of mini-course material, the panel found that the instructional materials are scientifically accurate and current. The question as to the methodology employed to review the scientific accuracy is not specifically addressed in the project material presented for review. It would be helpful to see the system diagram showing the flow of instructional material as it is prepared and reviewed.

It has been pointed out that this material relies heavily on the technology of today and thus has the potential to become outdated. It is therefore proposed that the authors and the publisher establish a contractual arrangement which guarantees the continual updating of these materials. Since the publisher is receiving a profit from this endeavor, the publisher has the responsibility to see to it that the materials remain current. The TPE management issues periodic newsletters with updated material, but no provisions have yet been made to follow up after expiration of the grant.

The TPE course is not based in any particular discipline and should be understood, and judged, as a multi-disciplinary program. The instructional material is not aimed towards the training of future scientists. Students who plan a scientific career are more likely to become explicitly or implicitly familiar with the TPE concepts in various disciplinary courses. The TPE course is aimed at producing young people able to analyze problems, to design strategies for their solution, and to apply these skills in a variety of encounters with contemporary technology. The term "technology" is interpreted in its broadest sense rather than as preoccupation with gadgets and machines.

For many academically weak students the completion of even modest portions of the TPE course constitutes an educational gain, since they might otherwise not participate in any comparable school activity. The TPE course certainly could increase the students' technological competence, and in this sense is a step in the right direction for American secondary education. However, the panel is concerned that this course should not be mistaken for what it does not attempt. Is is not a substitute for a <u>bona fide</u> science course, and it should not be treated as a less demanding alternative to such a science course for the abler students.

The course could easily be seen as a device for motivating the interested students to follow-up with a science course. A student could determine whether or not he or she is interested in science by taking a TPE minicourse. A positive response could lead to more advanced material. The TPE teacher's encouragement would seem to be crucial if these goals are to be achieved.

Question 5: Is the content of these materials educationally sound?

Technology, People and Environment is an innovative approach to dealing with secondary students whose aspirations, motivation or reading skills are at a low level. Traditionally, a primary objective of education has been to produce an informed citizenry. TPE attempts to develop a "technologically literate" student. While it is not a science course in the traditional sense, it deals with problem solving and decision-making in the tradition of the scientific method.

The developers stated that science departments have been enthusiastic about the program when used in place of traditional science courses which have had little success with the target students.

Specific preparation of teachers before they use the materials is critical to the success of the program. The panel strongly recommends that a definite, in-service program be established and required of all participating instructors.

The target group is identified in the materials as the "turned off" student. According to teachers these students are characterized by IQ's of 80-100, and irregular attendance at school. They are not usually motivated by the traditional science courses offered in secondary school.

The content/approach of TPE is suitable for the target group and seems to fit their needs for short term, activity-centered experiences. There is a danger that if the target audience is broadened, the basic tenets of the program may be inappropriate.

Certain potential problems in implementing the TPE courses could be avoided by selecting teachers who can deal confidently with students' value explorations and by investigating the legal aspects of class assignments that require activities off campus or out of school.

Question 6: Are the proposed and anticipated outcomes of these instructional materials desirable?

The materials purport to teach certain minimum science competencies that are not generally covered in other published instructional

materials. These were delineated in 1971 by The American Association for the Advancement of Science and National Association of State Directors of Teacher Education and Certification in their publication "Guidelines and Standards for the Education of Secondary School Teachers of Science and Mathematics."

Cursory examination gives the impression that the target population can learn what is being presented. These students are frequently unsuccessful and demonstrate little or no interest in traditional academic pursuits. The primary method of instruction is a "hands-on" or "activities oriented" format. A useful impact on some teachers could be the realization that such youngsters, properly motivated, can learn the skills and applications of science.

The executive director of the project indicated that at least two unintended effects had already taken place. The target audience of this program has been broadened to include non-college bound students as well as "below average" pupils. Also, because of student interest, the project staff developed supplementary materials embodying more advanced aspects of the mini-courses.

Materials are organized in such a way as to make it unnecessary for a student to attend on consecutive days. There is some question on whether this is desirable.

It appears that the authors have made an attempt to fairly represent all segments of today's society. The panel applauds this practice and recommends its consideration. The project developers state they have collected anecdotal feedback demonstrating high interest in TPE activities presented, better school attendance records, and overall higher morale among students and teachers.

Question 7: Do these instructional materials present implementation problems for the schools?

Teacher training need not be extensive as far as time and money are concerned, but it is essential that in-service activities be provided for all participants if the program is to be successful. It should incorporate the following basic areas:

(1) Criteria for selection of teacher and student participation in the program.

(2) Orientation of the target population to be served including students, teachers and parents.

(3) Clear and concise objectives and desired outcomes of the program.

(4) Review of the limitations and/or restrictions inherent in the program.

(5) Orientation in use and dissemination of all materials, equipment and processes.

The materials should not pose any special problems for existing organizational structures; but some method must be provided for determining the ability level of the students before they enter the program.

Two pieces of equipment are required to implement the full program: (1) an analog computer; and (2) a logic circuit board. The costs of this initial investment combined with printed materials costs on a per student basis compare favorably to program costs using textbooks and related laboratory activities.

Some members of the review committee were concerned that students will not meet the minimum competence in skills and concepts required by courses in science, social science, or mathematics if these curriculum materials replace the traditional science courses. As a result, the question of awarding credit may pose implementation problems within the schools using the program.

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

Project total and per pupil costs of the project materials are within an acceptable range. With the rapidly rising costs in publication activities, the estimates may be on the low side. The projected costs suggested by the directors are as follows:

Learning materials

Expendables:
$20/minicourse/200 students — $ 120.
Per pupil cost: $0.60 per year

Non-expendables:
Filmstrip, etc. $20/minicourse
Per pupil cost: $0.60
(probable life 5 years) =
per pupil cost/year $0.12

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Equipment

Logic circuit board $1,000
Analog computer, meters, etc.

Per pupil cost: $5.00
(probable life 5 years) =
per pupil cost/year $1.00

Using the above figures, the total cost to the students for equipment and expendables is $1.72 per year. This compares favorably with the costs of traditional science programs which exceed an average of $3.00 per year in some areas. It must be remembered that excessive rates of inflation are causing a rapid rise in school materials cost - as much as 25-40% annually in certain materials.

Refill needs estimated by directors of the project are approximately $0.10 per pupil per mini-course. These are reasonable rates and are comparable with traditional science courses embodying activity-centered modes of teaching.

Costs computed on a dollar basis are only one measure of the total expenditures in development and use of a new program in the sciences. Other costs may include higher than normal energy expended by teachers and developer during the developmental period with accompanying diversion of energy away from normal self-development, refinement of teaching skills, and advancement in education for those individuals intimately associated with the development tasks. These costs are frequently offset by increased expertise in planning, organizing, and writing skills.

It is incumbent upon all curriculum developers, including those of the TPE project, to recognize and consider seriously the impact of their new materials on students, and to use proper caution in advancing controversial materials in which value-laden concepts are fostered. For this reason it is important that developers provide mechanisms for adequate feedback and evaluation concerning such materials.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The evidence reviewed and a telephone conversation with project developers indicated that the initial activities eventually resulting in TPE began as a response to six teachers who, while teaching The Man Made World program, recognized the need for materials that would appeal to the less motivated students. Program originators reported that discussions

among the developers of the TMMW program and teachers using it, coupled with information obtained from interacting with participants at conferences where TMMW materials were being presented, reinforced the perceptions that a need existed for TPE-type materials.

Apparently no public announcements were made inviting interested individuals to step forward and contribute to the development of the materials; although project developers reported that subsequent to the initiation of the activities a Newsletter, with a mailing list of approximately 5,000 names, was used to apprise those on the mailing list of progress on the TPE program. The project directors reported that there was constant feedback from teachers involved in the program and that the direction and content of the program were modified in light of feedback received. For example, student criticism of paper-and-pencil activities resulted in substitution of more "hands on" activities.

As a result of teacher feedback, the actual target audience was changed to include not only the unsuccessful student but also more able students at a lower grade level. The wisdom of this decision is not at issue here; the fact is cited as evidence that feedback from those in the project actually did modify the program.

The work done by a member of the project staff and a graduate student in science education was cited as evidence of an external evaluation but it would seem unlikely that an evaluator in such a position could be considered to provide an external independent evaluation.

The reviewers received the impression that there was little formal evaluation of the program. Site visits, interviews and discussions with teachers and pupils in the program are, of course, essential but more formal evaluation would also seem desirable.

There seems to have been little mechanism for soliciting input from administrators or from the interested lay public (those engaged in merchandising, for example).

Evaluations were not systematic enough to allow project directors to convey to reviewers any substantial analysis of student reactions to the various aspects of the program, faculty reactions, or response of other interested groups.

In the future, the NSF should require that proposals include provision for feedback and evaluation of such a nature that results could be communicated to those not in the program. It follows that adequate funds should be available to make this possible.

The project appears to be appropriately administered from an analysis of the percentage of funds devoted to administration/management. The project director is assigned to the project 1/5 time; the co-director is assigned 1/3 time; and the project manager is assigned 70% time. The actual percentage time devoted to administration/management responsibilities as compared to development of program materials is not specified.

The question of program leadership is unanswered. It is assumed that the director and co-director devoted a large percentage of their time to leadership while the project manager was primarily concerned with management activities. The decision-making process and the individuals responsible for making some major decisions are not clear to the reviewers.

The project staff seems willing to share information with NSF and other interested parties through project reports, the medium of newsletters, and workshops at various national conferences. Specific information appears to be furnished on request.

The development of a concise comprehensive brochure accurately describing the project's philosophy, rationale, objectives, target population, learning activities, evaluation data, student and teacher reactions, scope and sequence of content, and anticipated products and usage is essential.

1) Additional comment by Dr. L. Scott Chalfant: "However, it should be clearly indicated in introductory statements that both administration and students were involved in the evaluation process of this project.

D. 16. d: TPE (Panel 4): Individual Panelist's Responses to 10th Review Question: What are your general impressions of the curriculum?

Panelist: Dr. Jacob Blankenship

The T-P-E program provides another learning option for the low-ability student. The content of the program is sufficiently unique that it does not compete with other programs since very few learning activities exist that deal with the interactions of technology, people, and environment. The mini-course format is also appropriate since it allows parts of the program materials to be used in existing courses. The uniqueness of content and format should increase the probability of use when the program is marketed.

The T-P-E program focus was originally on the development of curricular materials for low ability students. The broadening (shifting) of this focus to include a different target population is problematic. The original goals, objectives, and assumptions seemed appropriate as long as the original target population was being considered. I am concerned about the shift from low ability students to non-college bound students. The assumptions underlying the development of materials for these two groups are not necessarily the same. However, the project developers indicated that evidence exists that teachers and administrators suggested this broadened target population.

I would recommend that the project directors precisely identify the philosophy, goals, objectives, target population, learning activities, and evaluation measures and that this information be communicated to potential users. The substitution of this program for any course for other than a low ability student would, in my opinion, be questionable. Fundamental science principles, knowledge, and skills have a legitimate place in the curriculum and should be available to students of all ability levels. Special science programs for low ability students should be considered as learning options.

As stated previously, this program provides another learning option for low ability students and, as such, is appropriate and needed. The developers have contributed materials that would probably have not been developed otherwise and as such are due recognition. This type of development work should be encouraged. In future development work of this type, attention should be given to the points outlined in the preceding report.

Panelist: Dr. John Borriello

Overall my general impression is that this activity-oriented curriculum is productive in its attempt to reach the secondary school student who

has been academically unsuccessful. However in order to give substance to my impression there is a strong need for rigorous constructive evaluative material which I find lacking. This is particularly evident regarding student response. There is anecdotal material available but this is not useful in terms of the wide scale application for which this curriculum is intended.

Without such rigorous evaluative studies, one cannot know that what the curriculum intends to be learned is actually being learned and applied in everyday living. It is almost as if the consumer (i.e., student, teacher, parent, school district, etcetera) is asked on blind faith and speculative conviction to accept a curriculum of possible questionable value. In the future, what is needed is a guarantee of adequate funding of curriculums such as this in order to test their educational and utilitarian value in the development of our youngsters. Isn't it foolish to spend millions on programs without also allocating funds for their adequate evaluation?

Panelist: Dr. L. Scott Chalfant

My general impressions about the TPE Curriculum based on the materials and evaluations supplied are as follows:

1) The curriculum has real merit to fill a void for the slow learner, poorly motivated and often-absent student. However, I would suggest the following changes to make it more effective:

A. Definite criterion should be established for teachers who are most likely to be successful with this program. Since programs are "people" and the writers clearly indicate some persons will not be adaptable to this curriculum, it is essential criteria be presented for those likely to succeed and/or not likely to.

B. Time and funding should be provided for in-service training. Again, since it is the teacher that is the key to the program being successful or not, there should definitely be a planned and required in-service program for all teachers involved. Also, a general orientation for students and parents should be provided to avoid misunderstanding of the program and its objectives.

C. The content and activities largely reflect Caucasian, middle class values. Some adjustments should be made to incorporate values with which the minority student can identify since a high percentage of these students are likely to be enrolled due to the stated objectives and target population for the program.

D. Criterion should be established for the selection of the student population to be served by this curriculum. Since the target population base has broadened since the original proposal, I feel some confusion currently exists.

E. A more formal evaluation format should be designed and utilized.

The short capsule lessons have positive benefit for many students, especially those slow learners with poor motivation. With the expanded activities which have been added to the curriculum, a student who strongly identifies with a sub-topic or activity within the mini-course may now pursue it in greater depth beyond the 1 and 2 day period format.

Panelist: Dr. Donald Dean

I find the "Technology, People, Environment" program an effort to do something constructive for a large group of students whose educational needs are too seldom met: the unsuccessful learners. Society fails these students at its own peril. It is just such innovation that requires support, for the private sector's honest need to make a profit makes heavy investment in such innovation unattractive.

Since these students are not reached by the conventional science program designed for more able students, one that does interest them in constructive activity and in useful skills would seem to be an improvement.

I approve the interdisciplinary approach, the search for relevance, and the concern for technology, a significant part of our lives.

I am pleased that students are asked to weigh values and make value judgments. Secular education has too long avoided value judgments for fear of imposing values. As this project shows, imposition of values is not an inevitable consequence of exercise of decision-making and value judgment.

Some of the activities do not seem as interesting to me as they might, but perhaps I fail to appreciate them fully because I am not part of the audience for which they were designed. I trust that in future revisions the least interesting materials will be dropped.

I have expressed concern that this course will be taken to be a science course and thus eliminate science from the curriculum. It does not seem to deal with the broad principales of science to the same extent as such programs as BSCS Biology (even in BSCS versions prepared for

unsuccessful learners). I do feel that certain principles of science and certainly the processes of science should be part of the education of all students, not just the college-bound student. Perhaps it is even more critical for the student acquiring his terminal education to be exposed to the scientific principles.

As I understand this program, it is singularly inappropriate for it to be available to students with normal capacity for education. It is very difficult to control such matters but I should think it a real loss if students other than unsuccessful learners were to take this program instead of science programs. I should think of this as Gresham's Law applied to science education. I regret that the project directors do not seem concerned about the expansion of the target audience to include some able students.

Having expressed these reservations, I am satisfied that this program does address itself to the need of the unsuccessful learner.

I am glad that NSF is concerned about how potential users of new materials are to know about them and know how to use them effectively. It would certainly be a waste to develop an innovative program unless it serves to light the way. Perhaps professional journals in science education and professional societies could be encouraged to do their part in informing people of new programs. Perhaps contracts with publishers should specify the role of the publishers in promoting the new programs and providing inservice preparation.

Panelist: Mrs. Ruth Ganong

(I would question the validity of my comments on this project since I missed the investigation and discussion of the proposal.) However:

My overall impression of TPE is that it is an effective program that fills a need for the student who has not been involved in science curriculum. However, I think that it is important that a system of revision be established so that both educational techniques and the technological changes can be incorporated into programs at a later time. It will be essential that a program that is set up to help students cope with technological changes has the ability to change as technology changes.

Panelist: Ms. Sarah Hurst

Several significant studies of education in the past ten years have established that the usual curriculum of secondary education is designed primarily to meet the needs of the "academic", college-bound students. The T-P-E curriculum systematically addresses the

needs of students who comprise the majority of high school students--those with less academic aptitude and aspiration than the students who can reasonably be expected to achieve in the classic science courses.

The learning objectives have been identified by authorities in both physical and social sciences as valid and appropriate. The systems concept in the design is reinforced in the learning activities so that the student may be expected to utilize these "systems" skills in his personal decision making. Most of the problems used to exercise these methods seem relevant to the world in which these students live.

The multiple revisions of the TPE materials have been based on repeated field trials and direct feedback from students and teachers participating in the field trials. Two aspects of this procedure deserve comment. The final product of such a procedure should be more effective and a better "fit" to the needs of an identified target group than one author's perceptions of what such a target group should have and find effective (such as the result of the usual commercial publisher procedure). The other comment is that this procedure is expensive and therefore support is necessary from a broadly-based resource which has both responsibility and concern for public education. NSF seems an appropriate agency for such a process.

American education has always dealt with values, both by precept and indoctrination. If officially a national value is that we are a multicultural nation with equal opportunity for members of various groups, the school must permit examination and comparison of various value systems in order to affirm our own beliefs. The content of the T-P-E materials seems appropriate, both for the target group and the methodology proposed.

The limited dissemination foreseeable for programs such as this is discouraging. When an unmet need (such as this curriculum addresses) is prevalent nationwide, commitment of tax dollars to assure the availability nationwide seems appropriate.

The effectiveness of the curriculum is predicated on teachers who have had special preparation and knowledge of both content and approach. Funding to make available this crucial component may not be possible from the private risk capital of the publishers. Quality control of this in-service education would seem more secure if the project staff who developed the philosophy and materials could design and oversee the teachers' preparation.

Finally, the National Science Foundation should develop guidelines for components essential to good curriculum developments such as a data-based needs assessment, formative and summative evaluation. Budget must be adequate for these components and the program management

should require accountability in these matters of the project administration.

Panelist: Dr. Eugen Merzbacher

The TPE curriculum is a relatively inexpensive program with a well-defined goal. Its objectives, of helping low-ability students to become more at home in their contemporary, highly technological, environment, seem to me well worth supporting. However, the TPE curriculum should not be mistaken for, nor oversold as, a substitute science course. The skills which the course teaches are eminently useful for all citizens, but the course does not aim at an understanding of the laws of nature. Since the course tends to emphasize timely technological applications, it is likely to be subject to relatively rapid obsolescence. Incidentally, I would think that the time has come for such a course to "go metric" almost entirely. Finally, it seems to me that the material of the TPE curriculum which we were able to see carries a more strongly normative message than would appear necessary. Education and knowledge are, of course, never neutral, but I believe that the TPE materials would be more effective if they were more subtle and less pointed in their assessment of life in America today.

Panelist: Dr. Robert A. Peura

I feel the TPE materials are a good approach for teaching students that are not well motivated in school. There is anecdotal information that the program is succeeding to reach these students and teaches them to be literate in technology and science. The content of the materials for these underachieving students appears to be about right. However, if these materials begin to replace general science courses for most high school students, then the content must be carefully examined.

It is recommended that a formal scientific evaluation procedure be implemented in order to assess the true impact and value of these materials. In addition, it is proposed that a formal system for the training of teachers in these materials and a continual updating of materials be established. These procedures should be established in a contractual arrangement between the author and publisher.

Panelist: Mr. Harold Pratt

The TPE project represents the type of significant contribution that NSF support can make in science education. An identified need for new content development and emphasis has not been met by the free market. Greater capital investment is required than publishers are willing to invest because of the research and development needed to create totally new teaching strategies and because of the uncertainty of the sales market. The TPE project has effectively filled this void.

Because schools are slow to change priorities and the emphasis of instruction, extensive dissemination and implementation efforts will be necessary to introduce the TPE materials to the educational community. Financial support to provide information to schools via literature, seminars, conventions, and short workshops should be made available by the NSF. If schools make the decision to implement the materials, workshops should be available to train teachers in their use.

It is recommended that additional funds be provided to projects similar to TPE to more extensively evaluate the effectiveness of their materials with various groups of students. This should result in a better description of the audience being addressed by the course. In contrast to many projects, TPE appears to have been under-funded administratively and less comprehensive in its evaluation, dissemination, and implementation activities than desirable.

Panelist: Dr. Les Trowbridge

The course appears to be responsive to an identified need in the secondary schools, particularly in urban areas. It also recognizes the important contributions of technology to science and society, and provides a direct approach to highlighting these contributions for secondary school students.

There exists a substantial segment of the student population in secondary schools today for whom the traditional courses of physical science, biology, chemistry, and physics are not appropriate. These courses, as presently designed, are most appropriate for college bound students. The Technology - People - Environment course is an attempt to provide materials and alternative course options for the non-college bound segment.

The TPE course provides many creative activities for the students identified above. Its format facilitates the learning of many relevant technological topics on a short term basis which considers the problems of varied interests, sporadic attendance, and general apathy toward science and mathematics characteristic of this group of students.

While certain problems are evident in the materials, such as the overuse of written activities and high dependence on reading skills among students who may have an aversion to reading, the general thrust of the project is commendable.

Extremely important is the need to provide plans for teacher education on this course. The teacher, as with all courses, is the key person in determining the success or failure of the program. Dissemination and implementation plans are not clear, yet form a basic component in determining the growth and proliferation of this course in the schools.

Evaluation plans and procedures were minimally treated. Little data exists concerning student reactions to the course. Anecdotal records from teachers and pupils in the pilot schools constitute the main form of data collected. No reports of parent response were available. Achievement records are meaningful only in terms of the objectives sought. Closer relationships between the behavioral objectives which are stated for each lesson and the records of student achievement for these objectives is a necessary component of the internal evaluation of the project.

Based on the needs of the population for which the course is intended and the unique purposes identified for a special group of students, it is recommended that the project be encouraged to continue with appropriate funding. Project personnel should be apprised of the evaluative aspects of the program and the need to substantiate and document the results of activities appropriately.

Panelist: Andrew Turner

I think that the curriculum here is of too broad a base for me to make very many specific comments, even on something as general as general impressions. Generally speaking, therefore, I got a favorable impression of the curriculum. I found the student's reading matter to be clearly written and easy to understand, and the manner of presentation and organization of information to be concise and to the point.

However, I was not so impressed with the content of some of the instructional materials, although I felt most of it to be on target. A good example of this problem is the scenario of being lost on the Moon (section 17 of the "People and Technology" workbook). This subject will not appeal to the type of student we are trying to reach. I would suggest that the subject of this type of scenario be changed to one more familiar to the students, such as being lost in the middle of a busy city.

The values are perhaps the hardest thing to express an opinion on. They appear to be reasonable to me, a middle-class male white student. However, I am only a member of one minority group. I would say that in subjects like the ones we are dealing with it is impossible to please everyone, so you must try to please as many people as you can. Now the targets of this program are students with poor attendance, so we would do well to analyze who has poor attendance. I can point out three groups that make up the bulk of this block: the students who have low intelligence and have to work at or beyond their capacity to get by and do not want to, the students who simply "hate" school (because of nervousness, pressure, or the desire to do other things), and lastly the very intelligent students who are bored stiff with the subject matter available.

Let us now go through these groups. Any student who is very intelligent, of middle or upper class, and in a school that bored him would almost certainly get out and go to another school. Those students who "hate" school and are of upper or middle class would probably be under enough social pressure (from friends and relatives) to make them go to school on a regular basis.

The students of low intelligence of upper and middle class would probably either be sent to special schools (by their parents) or given special help (by their school), ~~so~~ that they would either be absent entirely or have a reasonably good attendance.

Therefore we can see that nearly all of the students we are schooling for (those with poor attendance) will probably be of lower class, and thus not very appreciative of middle class values. I would suggest that the project's creators go over their material with some representatives of the lower class and revise it so that it will appeal to them.

The approach is fine, I think the writing is sufficiently clear and the topic and sub-topic headings are suitable. Speaking as a student, I would say that the approach will probably reach nearly all of TPE's targets.

As for possible uses I would say that anyone's guess is as good as mine. In a conversation with the Executive Director of the project (Joe Piel) we learned that the original aim of the project was to reach "below average" students and many teachers found it satisfactory for use in courses for noncollege-bound students. From this we can see that TPE has and will have a weak variety of possible uses. I would say the problem here is that of too much use of TPE material rather than too little, which can lead to equally disastrous consequences. One case I have heard of (from the Executive Director)[1] is the accidental use of TPE material to prepare students for College Board examinations. As many students and educators are aware, these tests can make or break a student's opportunities to get into the college of his/her choice. Accidents like this one can hurt the project badly. Most likely it will put the TPE people in a bad light with the school where the accident occurred, despite the fact that it was probably a teacher's or an administrator's error that caused it.

As for recommendations, I feel that most of them that I have to offer have already been made. Some of those remaining are as follows:

Firstly, I would recommend that all the teachers who are to teach this curriculum are to read it thoroughly (to prevent errors like the one about the College Boards being made), and are to be encouraged to write back to the TPE people after the course, or a significant portion of it, is concluded. They might include both criticisms and ideas on how to make the curriculum better suited to its needs.

Secondly, I would suggest that some provision be made to prepare a follow-up course or courses for those students who find that they are interested in a subject they have learned a little about, in a mini-course. From what I have heard (again from the Executive Director, Joe Piel) I understand that steps in this direction have already been taken. I would close by suggesting that in the area of logic circuit boards that provisions be made for the students who wish to go on to write their own programs, and that similar steps be taken in follow-up curricula for all other units. I believe that one of the most vital things in projects like this one is to get the student interested and contributing to the program.

Panelist: Ms. Judy Yero

My impressions of TPE are based on a belief that a program of this type and for this particular target group is a real necessity. I am also impressed with the emphasis on the interrelationships between technology and society. While I might like to be able to add science to that relationship, I recognize that to try to cover too many bases at once might weaken the viability of the program. I feel that it is important that we judge TPE on its stated objectives rather than comparing it to existing science programs. To my knowledge, no good alternative exists in this area for students of this ability.

The approach seems quite appropriate as long as written work is generously interspersed with hands-on activity.

Dealing with values is a touchy area at best and the project staff should avail themselves of and actively seek input on the subject from ethnic and religious groups, business people and other interested citizen groups. Cooperation in the developmental stage can greatly ameliorate problems at a later date.

My major criticism is the lack of formal evaluation techniques. "Gut" feelings of those using this program as verbally communicated to project staff are valuable but by no means definitive. Evaluation tools covering student progress with regard to objectives as well as reaction to the program of students, teachers, staff and parents would be most helpful in defending and promoting the project.

Extreme care should be taken not to prostitute the goals of this project for the sake of broadening the consumer base. It is well designed for the low ability/reading level student but could be deadly at a higher level.

The project was well-conceived. If the changes suggested by the panel could be incorporated, it promises an innovative addition to the curriculum bank.

1) Comment by Dr. John G. Truxal:
"Apparently there was a lack of communication reliability here. The Executive Director recalls having emphasized that the materials should not be used under any circumstances as preparation for CEEB exams. He knows of no instance where this has happened."

D. 17. a: ISIS: NSF Descriptive Information

PROJECT TITLE: Individualized Science Instructional System (ISIS)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Ernest Burkman

INSTITUTION: Florida State University

DEPARTMENT: College of Education

BUDGET: Total Granted: $3,353,105

Dates: 9/72 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Develop a set of instructive materials designed to aid school systems in developing new and modifying existing curricula materials in order to provide flexibility in dealing with student abilities, variations in school science resources, and differences in teacher backgrounds.

PROJECT SUMMARY

OBJECTIVES

To develop a complete instructional system for high school science that can serve as an alternative to present high school programs. The system will be designed for individualization of instruction, for use by all academic levels of students, and for multidisciplinary studies emphasizing topics relevant to high school students.

ACTIVITY PLAN

Activities for 9/72 to 6/76:

a) Development of a specific statement of goals desirable for a high school science program.

b) Formulation of an overall matrix of minicourse topics.

c) Selection of a publisher.

d) Field evaluation of ten minicourses having titles such as: Household Chemistry, Heart Attack, Packaging Passengers, and Buying and Selling.

e) Development of a preliminary framework for the instructional management scheme.

f) Minicourse development:

1) 20 minicourses will be commercially available,

2) 30 will be in the final stages of field testing,

3) 10 will be in the initial writing stages, and

4) 20 (the remainder of the 80-unit package) will be in various stages of topic and/or author selection.

g) Development of the instructional management scheme.

Activities planned after June 30, 1976:

Two years (1976-78) will probably be required to bring about the completion of the projected 80 minicourses and to bring the instructional management scheme to the final testing stage. An additional two-year period (1978-80) should then be sufficient to make any necessary revisions and complete the NSF-supported development activities. Internal summative evaluation, centering both on the quality of the individual units and on the effectiveness of the system as a whole, will be carried out throughout the final stages of the project.

It will be necessary to produce a package of roughly 80 units to demonstrate feasibility of the system. The effort should then become self-sustaining, and additional units could be developed locally, by the publisher or by other commercial enterprise without additional federal funding. As currently envisioned by the project, the inventory of minicourses should eventually reach 125 units. Since a typical 3-year ISIS sequence would entail approximately 60 units, the student should then have considerable choice of topics of interest to him.

HISTORY

The initial proposal for the ISIS project resulted from the recommendations of a problem-assessment conference held in October 1971 at Callaway Gardens, Georgia. The thirty-five participants were selected from those university scientists, pre-college curriculum developers and school system personnel who were familiar with school problems and the accomplishments of instructional materials development during the preceding decade. The consensus of the conferees was that the development of a multidisciplinary treatment of relevant topics, structured in a flexible framework through the use of relatively short, independent units, would be the

most effective way to alleviate the shortcomings of the existing secondary school science curricula. The shortcomings as identified by the Conference are:

1) Few existing programs take into account variations in student backgrounds, interests and abilities.

2) Present programs tend to overemphasize "pure" science and neglect applications and social implications of science and technology.

3) The common biology-chemistry-physics sequence limits the correlation of concepts and effectively excludes ideas from other science content areas.

4) Existing materials tend to be inflexible.

5) Few programs effectively define instructional goals and determine the effectiveness of instruction.

6) Present curricula have not provided an adequate general science education for the majority of students.

PERSONNEL:

The ISIS project director is Dr. Ernest Burkman, Professor of Science Education at Florida State University. Dr. Burkman was a key figure in the development of the very successful junior high Intermediate Science Curriculum Study project.

D. 17. b: ISIS (Panels 4 and 6): Project Director's Response to 10 Review Questions

Part I -- General Considerations and the State of the ISIS Project

As indicated in the original ISIS proposal, the project was organized to develop instructional materials that would provide an alternative to those generally available for teaching science in grades 10 through 12. When the ISIS package is complete, we expect it to have these distinctive characteristics:

1. Provides maximum flexibility for local determination of course content and scope.

2. Contains material that is within the capabilities of most high school students and that will be of interest and value to them.

3. Encompasses an exceptionally broad range of science topics and practical applications.

4. Explicitly designed for conducting individualized instruction under existing school conditions.

Designing a materials package as comprehensive and innovative as that envisaged by ISIS is a most difficult task that will require several years to complete. At this point, less than half of the job has been done. In order to evaluate the Project's progress to date and the products it has produced, it is essential to consider where the Project is with respect to its overall developmental plan. Time and space requirements preclude a detailed discussion of this topic, but the comments that follow summarize our conception of the key points.

1. In simplified form the Project's long range plan is as follows:

   a. Establish a contractual relationship with a publisher before beginning full-scale development. Use the resources and expertise of the publisher from the outset.

   b. Determine a tentative general structure for individual minicourses and a tentative description of the content to be encompassed by the total set of minicourses. (See point 3 in later material related to Question 3 for details.) Choose a few topics that encompass a subset of the overall content definition, and develop draft minicourses that incorporate the tentative minicourse structure.

   c. On the basis of field test feedback on the initial draft minicourses revise the tentative general minicourse structure, the tentative overall content definition, and the initial minicourses. Draft additional minicourses using the new structure and definition (see Appendix 1 for procedures currently being used for producing draft minicourses). Repeat as often as necessary.

d. When 10 to 15 minicourse drafts show promise, and when the gross deficiencies of the general minicourse structure and the overall content definition have been removed, begin development of commercial editions. (See Appendix 1 for procedures currently being used.) Put first commercial minicourses on the market roughly eight months after submission of final manuscript to the publisher.

e. Develop tentative classroom management materials to accompany the early commercial editions. As the number of commercial editions increases, bring out subsequent, more comprehensive editions of the management materials.

f. Continue the development and revision of trial editions and their conversion into commercial editions until the full set of 80 minicourses is on the market. When the components become available, conduct field tests of logical clusters of minicourses to determine their cumulative effect (e.g., a chemistry course made up of appropriately designed minicourses).

g. Assist interested schools with implementing the final product.

2. To assure that overall development time is not excessive and that the full package of minicourses becomes available reasonably quickly after the first minicourse is put on the market, the Project has followed an almost impossible set of self-imposed deadlines to date. During the same period, 15 minicourse drafts have been revised and sent to the publisher for conversion into commercial editions. This is a production rate that to our knowledge is unmatched by any other curriculum project to date. Quite obviously, operating on such a schedule means that draft materials may contain more errors than might be the case if a more leisurely pace were employed. Because corrections can be made in subsequent editions, we have accepted this disadvantage in order to shorten the production pipeline and get quick feedback on the schools' problems in handling multiple minicourses simultaneously.

3. At this point the Project is engaged principally in activities c and d of the plan as outlined in point 1. Early this year a substantial revision was made in the general structure for individual minicourses, and final decisions were made with respect to part of the overall content definition. Manuscript for 15 commercial minicourses that reflect these changes have been sent to the publisher, and bound copies are expected over the six-month period beginning in December. The 10 trial editions published since September reflect the new minicourse structure (those published prior to this time are still in the old format).

4. As indicated above, <u>all instructional materials produced to date are experimental drafts</u> that are labeled as such and have been given

limited distribution. Only schools that have volunteered to use experimental draft materials have been authorized to do so. Eighty-seven of the trial schools that are participating in the test are not only doing so voluntarily, but at their own expense as well. (Trial editions are provided at Project expense to 46 trial schools.)

5. By definition, ISIS draft materials contain procedures, content, and illustrations that ultimately prove to be inappropriate. When feedback indicates a need to adjust the general approach to instruction or the details of particular draft minicourses, the changes are made in subsequent drafts. There is no way to know in advance how drafts will work or be received. If there were, there would be no necessity for field testing.

6. Although the Project expects all minicourses to be educationally useful, no single minicourse is likely to fit all situations or be appropriate for all youngsters. One of the objects of field testing is to discover the conditions under which a given minicourse works best. The Project plans to use the information it gets as a basis for making published recommendations to school systems as to which minicourses might be used under a given set of conditions and with particular types of students.

7. As indicated in point 1, the Project has made changes in the pedagogical style of the minicourses and has improved its procedures for determining and checking content. This means that draft minicourses published recently are closer to our current thinking than are those published some time ago. (One possible exception to this generalization is in the use of cartoons for motivation and instruction. This area of our approach is still highly experimental.)

8. The Project plans to ultimately publish materials for all types of students, and minicourses that deal with many disciplines. But minicourses are being released according to perceived educational needs. In setting up the development and release schedule, we are giving highest priority to materials for the student who does not plan to enter college and to the college-bound student who is not likely to major in science. As yet, we have not chosen to give much attention to materials for the college-bound student who plans to major in science.

Part II -- Resource Material Related to Particular Questions

Question 1: Is there a genuine need for these instructional materials?

1. The subsequent material related to Question 2 is relevant to this question.

2. The ISIS Project was designed in response to several needs that were perceived at the time the proposal was submitted. These are discussed in the Report of the Callaway Gardens Conference published in 1972 and summarized in the article "New Directions for Science Teaching," by Ernest Burkman (The Science Teacher, February 1973. See Appendix 3.) Stated in oversimplified form, the major perceived needs that were identified and the Project's method of responding to them are as follows:

A. Need: High School science materials appropriate for students that will not attend college and for those who will enter college but not major in science.

Response: (1) Most minicourses developed to date feature a "core" containing content judged to be of importance to the average citizen, and "advanced activities" judged to be appropriate for college-bound nonscience majors. (See "ISIS Teacher's Manual - Doing Minicourses" for details.)

(2) The format and language level of the core and excursions are designed to minimize the number of students who can not or will not learn from them. (See Appendix 4.)

(3) By allowing students to travel at their own pace through activities pitched at varying levels, and to omit activities covering content already mastered, the materials tend to tailor learning to ability level. (See "ISIS Teacher's Manual - Doing Minicourses" for information on this process.)

B. Need: Flexibility to permit local construction of curricula to meet local needs.

Response: The provision for asequential modules that cover a wide range of topics will maximize freedom of choice, and the assembly of an almost unlimited number of content scopes and sequences.

C. Need: Increased emphasis in high school science courses on disciplines other than biology, chemistry, and physics, and on applied science and the social implications of science.

Response: These types of content are being systematically built into minicourses where and when appropriate.

D. Need: Instructional materials appropriate for individualized instruction.

Response: The ISIS instructional model is explicit on this point. (See "ISIS Teacher's Manual - Doing Minicourses" for details.)

Question 2: <u>Is there a market for these instructional materials?</u>

1. Since publishers are probably the most discriminating judges of market, the Project's experience in selecting a publisher is relative to this question. <u>Prior to the publication of its first trial materials</u>, the Project went through a series of steps to inform the publishing industry of its plans and ultimately issued a request for proposals re becoming the distributor of the materials. Throughout this process, there was high interest in the project among publishers and four firm proposals from major publishing firms were received. Ultimately a contract was negotiated with Ginn and Company that has been judged by NSF as favorable.

2. Ginn and Company's market surveys have resulted in an anticipated penetration of some 22,000 classrooms over a five-year period.

3. Because no commercial materials are as yet available, no formal implementation of ISIS has begun. The Project has, however, considered the problem (see Part IV of the 1974 ISIS Proposal) and has taken some preparatory steps as follows:

   A. In four separate meetings, ISIS consultants and/or advisory board members considered the problems that schools will likely face in implementing ISIS and recommended ways to solve these. Using this input, the Project has thought through a rough plan for providing the needed help. In essence, this plan calls for the Project to train resource people who, in turn, would train local people from districts interested in ISIS. The local people would in turn, carry out the necessary teacher-training activities. (See Appendix 5 for more detail.).

   B. A number of resource people have already been trained. These people are of four types: (1) former staff members and participants in writing conferences; (2) tryout teachers and center leaders; (3) participants in the 1975 summer resource training sessions conducted with NSF support in San Diego, California and Tallahassee,

Florida; and (4) Ginn and Company science specialists (training session by ISIS planned). The geographic distribution of these people is spotty, however, and no real organization of effort has yet occurred.

C. Until last summer ISIS anticipated that more resource people would be trained and that local and federal disseminating funds would be available to them in addition to the funds that the publisher has agreed to supply (See Appendices 5 and 6). For this reason, we hope that the Congress sees fit to reinstate the NSF Implementation Program.

Question 3: <u>Do these instructional materials possess a clear purpose and rationale?</u>

1. Previous sections of this paper are relevant to this question (see especially page 1 of Part I, and the information related to Question 1). In addition, the following are recommended reading:

   A. "Final Report of the Callaway Gardens Conference on Building A Multiyear, Multidisciplinary High School Science Program," October 1971. (Note especially pages 1-10.)

   B. "New Directions for High School Science," Ernest Burkman, <u>The Science Teacher</u>, February 1972. (Appendix 3)

   C. Original ISIS Proposal, 1972 -- note especially pages 1-9.

   D. Selected Articles from back issues of ISIS Newletters (see Appendix 6).

   E. "Unhooking High School Science: The ISIS Project," Ernest Burkman, <u>The Science Teacher</u>, October 1974. (Appendix 7)

2. The Project strongly recommends that anyone wishing to interpret the ISIS instructional materials begin by studying the revised edition of the ISIS "Teacher's Manual - Doing Minicourses." This pamphlet describes the components of a typical minicourse and what each is designed to do. The ISIS "Teacher's Handbook - Managing ISIS" is also recommended preliminary reading since it gives the Project's recommendations to teachers as to how to actually use the materials.

3. The phrase "rationale for the selection of individual curriculum modules" can be taken to infer either of two questions: (1) On what basis are the topics for the individual modules chosen? and (2) On what basis should schools decide which modules to include in their curriculum? The first question is covered by the materials suggested under Point 1 above. With respect to the rationale for choosing topics, the following procedure has been used:

A. Utilizing input from parents, high school students, scientists, science educators, and science teachers, two lists of science content have been evolved by the project staff. One list consists of specific science-related information that is believed to be of value to the average citizen. Statements that describe this content have been titled "Unitary Objectives." The second list contains statements of more general science-related principles and skills that are believed to be of similar value. These have been titled "Cumulative Objectives," (See Appendix B for more information on Unitary and Cumulative Objectives and how they have been determined.) Over time the Cumulative and Unitary Objectives lists have been refined. At this point the list of Cumulative Objectives is relatively final as are the Unitary Objectives related to the life sciences and chemistry and physics. These lists have been supplied.

B. To date, topics for minicourses have been chosen such that:

(1) A reasonable number of "Unitary Objectives" are encompassed.

(2) One or two "Cumulative Objectives" can be exemplified within the context of the topic.

(3) The materials will be reasonably interesting to high school students.

(4) Activities can be constructed that are effective and practical for school use.

(5) The topic suggests a reasonable amount of content that is appropriate for college bound students and that can be built into " ed Activities".

C. A further consideration in selecting topics has been the assumption that among the total set of minicourses there must be sufficient numbers dealing with life science, chemistry, and physics to construct one year courses in these areas and that the other major science disciplines should be reasonably represented in the package.

D. At the moment, the Project is considereing other basis for selecting minicourse topics to accommodate special needs of the college-bound student.

More information on the subject of topic selection may be found in the following sources:

(1) Original ISIS Proposal, 1972. (Note especially pages 15-19.)

(2) Subsequent ISIS Proposal, 1974. (Note especially pages 1-3)

(3) Excerpts from ISIS Newsletter #3. (See Appendix 10)

Question 4: Is the content of these instructional materials scientifically correct?

1. Appendix 11 contains an excerpt on this subject from a recent letter fr Ernest Burkman to Dr. Harvey Averch, Acting Assistant Director for Science Education, NSF. In the excerpt the Project's criterion for accuracy is expressed.

2. Points 2 through 8 of Part I of this paper are relevant to assessing the content accuracy of the existing materials.

3. Appendix 1 provides flow charts and brief descriptions of the process currently used by the project in generating trial and commericial editions. Note especially the attention given to content accuracy checks.

4. Appendix 12 is a list of content specialists who, at the request of ISIS and/or Ginn, have reviewed trial and/or commericial materials for content accuracy.

Question 5: Is the content of these instructional materials educationally sound?

1. A number of the earlier sections of this paper bear on this question; see especially points 6, 7, 8 of Part I, and all of the material related to Questions 1 and 3.

2. It is especially important to note that the Project's efforts to date have focused primarily on the student who does not plan a career in science.* This category of student includes those who plan to terminate their education after high school; and those who plan to enter college, but not major in science. With minor exceptions, we assume that the core activities and the advanced activities cover content appropriate for the college-bound nonscience major.

3. As indicated in Appendix 4, an open page format and exceptionally heavy use of illustrations characterize the ISIS minicourses, and in particular the "core" portion of them. These techniques are designed to help motivate disinterested youngsters and encourage them to stay with science.

*This priority does not connote a disdain for the science prone student, but rather indicates our judgement as to the greatest current need. Later we plan to turn our attention to the potential science major.

The use of cartoons performs a similar function but we are less sure of the effectiveness of this technique.

4. With respect to controversial or value-laden topics, the following can be said:

   A. One of the reasons for developing modular instruction is to increase the possibility for local schools to choose the content to be included in the curric[illegible]. This is especially important when it comes to sensitive [illegible]s. The modular approach will allow School A to teach Topic B without imposing that topic on School B.

   B. During field testing, the Project has made a special effort to avoid forcing unwanted sensitive materials on trial schools. A case in point is the handling of the 1974-75 field testing of the minicourses "Birth & Growth" and "Human Reproduction." (See Appendix 13 for details.) We plan to follow a similar procedure in the future in connection with any trial minicourses that appear to contain sensitive material.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

1. Much information relative to this question appears in earlier segments of this paper. Note especially the material for Question 1 and Question 3.

2. With respect to eliminating bias and stereotyping, the following can be said:

   A. The Project staff has been sensitized to the need to eliminate bias and stereotyping and are making every effort to do so. We think that our proficiency in spotting and eliminating bias has improved. Toward this end, three ISIS staff members attended a special briefing on this topic at the Boston Headquarters of Ginn and Company. The Ginn guidelines re eliminating bias (see Appendix 14) are being used in the production of commercial editions.

   B. A quick examination ~~of~~ the Ginn guidelines will indicate the difficulty in satisfying all demands in this area.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

1. Earlier material in this paper bears heavily on this question. See especially point 3 related to Question 2. See also pages 13-14 of the original ISIS Proposal.

2. The general thrust of the project has been to minimize the mechanical barriers to implementation. For example, equipment costs and existing school inventories have been considered in selecting equipment for activities. Also, we have deliberately kept audiovisual requirements minimal. We have also tried to make the system for individualizing instruction practical for use under existing school conditions. A major dimension of our field testing relates to the question: "Can mortal teachers working in real world classrooms make the system work?" At this point our answer to the question is a qualified "yes." (For an explanation of the qualification, see 3 and 4 below.)

3. The difficulty of implementing ISIS will vary greatly depending upon how many minicourses are chosen and which ones. If relatively few minicourses are chosen and their content fits into course titles already existing in the school, their activities call for little laboratory equipment beyond that which is already available, they contain few sensitive topics, and if they are taught by knowledgeable teachers with experience in individualized instruction, the problems will be minimal. On the other hand, other combinations of teachers, school plants, and minicourses could make implementation severe indeed.

4. As is the case with most curriculum innovations, the teacher is the key to how well ISIS works. Teachers who choose to use minicourses that encompass unfamiliar content would obviously profit from some upgrading in that area. But content training does not seem to be the biggest factor in success in teaching ISIS. Making the technical and emotional adjustments inherent in individualized instruction appear to be the big factor. Most teachers will require training in these areas to do an optimal job in an ISIS classroom.

Question 8: Are the costs for implementing these instructional materials reasonable?

1. ISIS materials are very flexible in that different combinations of minicourses, cassettes, resource units, equipment, tests and teacher's guides will be purchased by schools. Some schools will deploy the materials for quinmester or semester offerings -- others will initially use materials as supplements to their existing program. The cost, therefore, is a direct function of amount of materials needed.

   From the outset, ISIS has tried to make maximum use of science equipment already in the schools and has been committed to keeping both initial and replacement costs to a minimum. (See pages of the original ISIS proposal.) The Project has conducted a survey of schools to assess the probabilities that given equipment items are already on school shelves and designed its activities accordingly. Also, Ginn and Company is marketing the equipment component of ISIS such that schools may procure only what they lack.

3. On the assumption of a "standard" one-year course, the per-pupil first year installation costs for commercial minicourses are estimated at $6.30 versus the first year cost for a traditional program of $12.90. No comparable materials are available at any cost. See Appendix 17 for projections for installation and maintenance costs for five years made by Ginn and Company.

Question 9: <u>Is the management/organization plan adequate for producing these materials?</u>

1. Earlier segments of this paper are related to this question. See especially points 1 and 2 of Part I (Appendix 1 is of particular interest here), point 3 relating to Question 3, and point 3a relating to Question 2.

2. Personnel associated with ISIS are of three types. First there is a permanent staff which operates full time in Tallahassee. These people are responsible for overall project planning, conduct of all field testing, and part of the generation and revision of minicourses (see Appendix 15 for names and brief vitae). Much of the initial work on trial minicourses is done by author consultants who work at home part-time or work full-time in summer writing conferences (see personnel lists in recent minicourses for names). In addition, the advisory board supplemented by short-term consultants provides regular advice and counsel to the Project on on-going problems (see Appendix 16 for a list of advisory board members.)

3. About two years ago the Project made a change in the organization of the advisory board (see page 8 of the 1974 ISIS-NSF Proposal for details and rationale). The reorganization resulted in very minor changes in board personnel. A few deletions and additions were made to increase the balance of talent.

4. Our early experience with the use of consultant-authors working at home in the mode described in the original proposal (see pages 19-21) has not been promising. The competition provided by at-home activities and responsibilities has resulted in delayed manuscripts and it has proven difficult to communicate with respect to level, instructional style, etc. As a result, the Project is now depending more heavily upon the writing conference approach to generating materials with good success.

D. 17. c: ISIS (panel 4): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The need for the ISIS program was well established at the Callaway Gardens Conference, which was held in October 1971 and the results reported in The Science Teacher in February 1972. The conference report outlined several needs for high school science programs:

1. Science materials should be developed for students who will not attend college and for those who will attend college but not major in science.

2. Local school systems need a wide variety of instructional components or modules to create their own courses of study.

3. Science materials should have a greater emphasis on the application and social implication of science.

4. Science curriculum materials should be designed for individualized instruction.

The conference participants included a wide range of authorities representing many scientific and educational organizations.

One of the first activities of the project was to survey a large number of science teachers, students and parents on the importance of a list of goals and objectives for all graduating high school students. The goals and objectives established by this very extensive input were used to guide the overall selection of minicourse topics.

Widespread local efforts have been made to develop individualized science materials with the support of local funds or limited ESEA Title III funds. The proposed framework for science education for the State of Texas requires the use of minicourses by local school districts. At this stage, virtually no nationally published materials exist to meet these needs.

The need for individualized instruction and flexible instructional materials presented by the project is consistent with statements that repeatedly appear in the professional literature.

The decreasing science enrollments during the past 15 years lend further support to the assessment of need for new alternative forms of science materials.

The panel estimates that the materials produced by the project have the potential of being used by approximately 2/3 of the high school population. Only the two extremes of academic ability (the very weak student

and the future college science major) would not be reached by these materials.

Question 2: Is there a market for these instructional materials?

Development of modules and minicourses is occurring throughout the country for some of the same topics and levels being treated by the ISIS program. Some examples are the IAC (Interdisciplinary Approach to Chemistry) and the modularized science program in Texas. No other program is attempting to produce modules or minicourses on as broad a scope, in as great variety, and with an individualized format as the ISIS project. To develop a complete science program consisting of 60 to 80 minicourses to supplant or supplement the three years of science in the traditional offerings is an extremely ambitious undertaking. The concept is commendable and if carried through successfully, will help restore the general education function of secondary science. At the same time the interdisciplinary nature of science will be emphasized and the extreme compartmentalization of the current high school sciences will be partially overcome.

In most cases, the minicourses of ISIS will probably be looked upon as additional resources to be selected as time permits or special needs require. Experienced, competent science teachers will be able to design individually oriented science programs for those students who can profit from them. Less experienced teachers who wish to retain a substantial degree of traditional structure may use the minicourses as supplementary materials or interesting diversions.

The plan for dissemination is predicated on funds for teacher workshops and seminars to be provided by the publisher. While the moneys allocated annually will be limited, they will support training activities for a nucleus of additional teachers to begin implementation of the ISIS materials. If these methods are successfully demonstrated, NSF should be encouraged to consider support of the implementation and dissemination efforts.

The positive response of the commercial market is deduced from the report by the project director that four publishers bid on the ISIS materials. The project management selected the most favorable of these bids and contracts with Ginn and Company have been negotiated (with NSF approval). Ginn and Company predicted that the ISIS materials will be used in approximately 22,000 classrooms. The financial support of the teacher in-service education described earlier in the panel's report is part of this contract. The panel inferred that these publishers had carried out market surveys and feasibility studies before bidding.

Question 3: Do the materials possess a clear purpose and rationale?

The panel finds that the "unitary" and "cumulative" objectives enunciated by the project are valid and straightforward. The minicourses of ISIS

are the realization of a much-talked-about concept, a flexible system of self-instructional materials for the learning of science at the high school level.

The instructional texts themselves suggest that the new curriculum should appeal to students with lower reading skills. In style, the ISIS books are candidly written for the comic strip and TV generation, but in content they aspire to broad and fairly thorough scientific coverage.

The materials are uneven in many respects. Some courses are clearly presented, but others are obscured by pictorial gimmickry. The panel notes that there is an elaborate mechanism which the project uses to review, correct, and improve the various units through an iterative procedure. However, it appears that the initial manuscripts are produced in summer writing conferences under time constraints which are not conducive to the achievement of consistently high quality.

Since ISIS is intentionally nonsequential, the cohesiveness of the material can only be judged by examining the complete set of minicourses. Such a detailed examination was out of the question, but the panel is persuaded that ISIS cannot be faulted for being too narrow. The great advantage of ISIS is the flexibility of the minicourses, and there is every opportunity for teachers to make the coverage as complete as desired.

The panel believes that the goals of the ISIS curriculum can be realized if students are exposed to a large enough portion of the course. An example may illustrate how the unitary objectives are worked into the instructional material as well as some problems inherent in the texts.

Objective #18 asks that the student be able to describe some common phenomena and devices in terms of an electromagnetic radiation model. The panel traced this objective in two minicourses on radiation and on communication ("Sending the Message") and found the two treatments entirely unrelated and disparate in level of sophistication. However, the panel is much less concerned over differences in degree of difficulty than over differences in quality of presentation and in meaning.

It may be argued that these inconsistencies of the text material are secondary in importance and that it is the teacher who determines a student's chances of succeeding in this or any other goal. In any event, the panel believes that ISIS has the potential of meeting its set goals by its complex scheme of testing the material in pilot schools, revising it, and testing again.

Question 4: Is the content of these instructional materials correct?

The panel finds wide variation in the scientific quality of the text materials. It finds factual errors, which can easily be corrected, but,

more important, it finds instances in which material could have been better presented from a scientific standpoint.

The panel recognizes the fact that it is sampling material and that the materials it examined are in various stages of revision. It is essential that future revisions correct problems of scientific accuracy and presentation. Here, as in other sections of this report, the panel expresses confidence in the feedback process employed in the project and hopes that this will accomplish any correction needed in the presentation of the scientific material.

The fact that the material is modular makes such correction relatively easy. It will also facilitate revisions needed to keep the material current. The level of the materials is calculated to be modest, so that a large student population can be reached and given an opportunity to study modular science. By the same token, ISIS is not recommended as an early preparation for future scientists.

While the panel appreciates that the non-sequential nature of the curriculum precludes a comparison with conventional science curricula with regard to completeness of coverage, the panel advocates greater coordination among the various related and overlapping modules, not for the purpose of avoiding duplication or of filling gaps in coverage, but rather to insure a more uniformly and consistently high quality (not necessarily high achievement level!) of the presentation.

Question 5: Is the content of these instructional materials educationally sound?

The consensus of the panel is that the final form of the ISIS materials will be educationally sound. The cumulative objectives have been evaluated by representatives of appropriate groups. The overall scheme for relating minicourses to unitary and cumulative objectives seems balanced. The revision process should eliminate any adverse reactions that might arise. Opportunities for input at each stage of development enhance the prospect for favorable reactions to and general acceptance of the curriculum.

The minicourse format has been recommended as a solution to the problem some students have in following through the long content sequence of the traditional science course. On the other hand, the same format can create adverse reactions from teachers who cherish the traditionally sequenced science program.

Both the flexibility provided by the minicourses and the student involvement in choosing his learning activities demonstrate an innovative approach. The evaluation data indicate that students also may sharpen their self-perceptions as they appraise their own achievement in deciding which part of the minicourse they might skip.

The panel questions the wisdom of broadening the original target population of the ISIS materials. It has been recognized from the beginning that

ISIS is not designed for the science-prone, college bound student.

Value laden topics and activities are most often treated in an open fashion. Several members of the panel question whether the comic strip sequence enhanced the impact of the Human Reproduction unit. (pp 8-9-10). Members agreed that, except for the cartoon, the information is appropriate for the unit.

If the cumulative and unitary objectives identified by the project are valid and later test data indicate that students are achieving these objectives, ISIS should be considered a success. It should be judged on this basis as an alternative rather than compared to traditional programs.

Question 6: Are the proposed and anticipated outcomes of these instructional materials desirable?

The anticipated impact of these instructional materials on students who have not been successfully involved with science courses will be desirable. The format of the program permits students to explore areas at their own rate of learning and pursuant to their knowledge and interest. Graphic illustrations and cartoons are used extensively to enable students to grasp concepts which they might miss in a written text. In some instances, as noted before, the graphics seem overly emphasized such as in the human reproduction unit.

The many minicourses offer a fresh infusion of presentations to students and broaden the scope of curriculum offerings. The project director stated that individual teachers can successfully manage up to twelve units in the same class at a given time.

The individualized instruction while providing an exciting instructional format does present possible classroom problems. If the instruction methods are not varied it is likely that the students will become bored with the same style or mode of learning each day. Thus, the classroom instructor should consider using various modes of instruction (film strips, demonstrations, small group discussions, etc.)

The content and approach of the material that has been reviewed seem to be unbiased and fair. The individualized instruction approach gives students a great deal of freedom and allows them to work and learn at their own rate. This process feature is unique and innovative for teaching high school science.

Question 7: Do these instructional materials present implementation problems for the schools?

The panel believes that teachers need training in individual instructional methods and techniques in order to teach these materials successfully. We further believe that competence in science is another prerequisite.

The short topical minicourse units and related laboratory activities allow a wide range of flexibility in implementation. Violence will not be done to existing curriculum and school organizational structure.

These materials are developed to accommodate a wide range of student achievement and interest levels. The "core" of the courses is written in language which is directed toward the average to below average student in terms of vocabulary and reading level with "advanced activities" designed to serve additional needs of the more advanced student and "excursion activities" to serve additional needs of the remedial student.

Although a number of the activities and minicourses have value-laden materials, the presentation is such that discussion and content do not impose specific or selected value interpretations. Indications are that minicourses containing value-ladened topics are carefully reviewed by experts in the related fields to determine their probable effects on the students. Individual minicourses can be screened and selected or rejected by the local school districts.

Question 8: <u>Are the costs for implementing these instructional materials reasonable?</u>

Total costs for implementing the ISIS program may be estimated only roughly. Materials for students are estimated by the project developers at $6.30 per student per year for the initial year of operation. This is approximately one-half of the cost of initiating a traditional laboratory based course in science.

For a five-year period, the average per pupil cost is estimated at $2.63 per year, compared to $5.32 per student per year for traditional science courses. This is a favorable comparison and is made possible by the use of simple and "home-made" apparatus and equipment in the ISIS course.

It is worth noting, however, that in all likelihood, the ISIS materials will be used in conjunction with or supplementary to the traditional science courses in most high schools. This means that the projected costs may be in addition to the regular costs of operating the science program.

It must be mentioned also that the life of minicourse materials (paperback texts, mimeographed sheets, etc.) is usually shorter than that of materials used in traditional courses, where hard-cover textbooks and durable apparatus are used.

The projected implementation costs of the ISIS program appear reasonable. While initial costs of a new and experimental program can be expected to exceed those of a stable program, the long-range expense of putting this program into a high school is not excessive.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

Commendable steps were taken to provide input from educators, scientists, students, and the public from the very start of the project. The unitary and cumulative objectives were developed with input from a variety of persons with something to contribute.

Throughout the development of the project, ample opportunity for feedback and check on quality has been provided. Material prepared by the writing team is somewhat hastily checked by reviewers before it is sent to the test centers. Following field tests, those authors responsible for the revisions are provided a comprehensive set of feedback materials. The teachers at test centers answer questions about the material and annotate the minicourses with their comments. They may submit tape recordings of their discussions of the material. Student reactions and performances are analyzed along with data on student characteristics. Where student performance is less than expected, efforts are made to learn why this is the case and the materials are improved accordingly.

A board of consultants is available to those developing the materials and to those revising them. We are not in a position to know to what extent consultants actually participate in control of the quality of the product. In addition to consultants to the project, consultants to the publisher make their contribution.

Although the report was not made available, the panel was pleased to note that there was an external substantive NSF evaluation of the program. The panel is generally well impressed by the evaluative efforts of those associated with the ISIS project.

Evidence submitted to the panel indicates that the ISIS Project is adequately administered. Specific questions directed to the NSF project manager and the ISIS project manager resulted in the panel forming the opinion that the project administration is neither top heavy nor too thin.

The project staff appears to be providing adequate information to NSF and other interested parties in a systematic way. Specific information is furnished on request. The Project Director provided comprehensive responses to all questions asked of him in the conference telephone conversation.

Reiterating an earlier point, the panel is concerned that minicourse materials are sent to trial schools on such a short timeline that errors are not screened out prior to the materials reaching the students. Some attention should be given to the development of a management system that would insure that instructional materials are more nearly error free with regard to scientific content prior to being released to students even at the initial trial stage.

D. 17. d: ISIS (Panel 4): Individual Panelists' Responses to 10th Review

Question: What are your general impressions of the curriculum?

Panelist: Dr. Jacob W. Blankenship

The ISIS curriculum is impressive in its uniqueness. The concept of minicourses is rapidly being accepted as a viable alternative to the conventional structuring of courses. Both the number of minicourses to be developed and the variety of topics to be covered will provide flexibility to schools and learning options to students that have heretofore been unknown. The thoroughness with which the unitary and cumulative objectives were identified and verified increases the quality of the materials from the standpoint of coverage of scientific principles, concepts, and skills. The curriculum should find a ready market.

Effort should be made to improve the quality of the trial version of the minicourses prior to their being used by students. Students, teachers, and parents have a right to expect curriculum materials that are scientifically sound even when the materials are in trial editions.

The use of cartoons in the human reproduction unit tends to obscure the facts being taught. While the cartoons are not offensive, they do not appear to contribute positively to the minicourse. The use of cartoons in any minicourse should be carefully considered and some attempt should be made to actually determine their value.

The problems to be faced in implementation of these minicourses are real ones that should be candidly addressed and appropriately resolved. The philosophy and assumptions underlying the minicourse concept will call for in-service type activities during which teachers should have opportunities to learn classroom management skills and the opportunity to thorougly explore the rationale. The exciting possibilities being opened up with the advent of these minicourses should not be restricted due to teachers being asked to use the materials without appropriate in-service activities.

My overall response to the ISIS Project is very positive. This extensive and innovative effort would probably have never been undertaken without funding such as that provided by NSF. Although some problems exist, as noted above and in the preceding report, the problems seem minimal when compared to the contributions being made to science education by this project.

Panelist: Dr. John Borriello

A sampling of the curriculum materials demonstrates an applied everyday living approach to the teaching of science. Some materials may be controversial to selected consumers. Some parents, for instance, may object

to the human reproduction, birth and growth sections. As a result these sections may indeed need parental consent before implementation.

On the whole, the intent of this curriculum is admirable. In my opinion its approach would tend to maintain interest and motivation for learning in youngsters.

Panelist: Dr. L. Scott Chalfant

My feeling is this project is one of the most ambitious I have seen and, to date, certainly has produced a large volume of meaningful mini-course units in a relatively short period of time. Although I would be the first to admit that some of the materials can use refinement, the following advantages of these materials seem significant:

(1) The developers have used an innovative, interdisciplinary approach for presenting concepts and learning activities based on current and/or relevant topics.

(2) The materials developed as mini-unit packages provide a wide range of flexibility for both the students and teachers in two respects: (A) They are truly individualized providing opportunity for student self-selection and evaluation; and (B) they allow the teacher to use the materials as a unified interdisciplinary course or as supplemental materials to existing courses of study.

(3) There are extensive opportunities for the students to apply their knowledge and skills and/or test the concepts and objectives presented.

(4) The objectives have been determined from a broad base of input representing many segments of our society.

(5) The materials developed serve a much broader range of students than most. With the materials divided into three separate categories of: (1) core; (2) excursions; and (3) advanced activities, they serve a large group of students from the low-average to the high-average.

I do have the following concerns and recommendations:

(1) The development of a management system which is one of the project objectives should have been developed and made available earlier to the consumers of project materials.

(2) Since the materials are highly individualized, care should be taken to provide in-service training in individualized instruction if the materials are to be properly utilized. Appropriate funding should be established for this purpose.

(3) Continued, and perhaps more concentrated efforts should be directed toward assuring scientific correctness of materials even before the "trial schools" test them.

(4) I recommend that an independent evaluation team be assigned to assess the degree to which the project and materials have met their objectives and establish a long range evaluation design for the total project.

My impression is this project and related curriculum could have a positive educational impact on a large number of students if the materials continue to be refined and disseminated.

Panelist: Dr. Donald Dean

The project is an ambitious undertaking: to produce 80 or more minicourses that can be assembled in various combinations to satisfy science needs of a variety of high school students.

The minicourses examined were in various stages of revision but even granting this, they were of widely varying quality. Some seemed very well done; others need extensive correction and revision generally.

The minicourse on Human Reproduction is a good example of what I thought to be badly done. The cartooning, attempts at humor, and funny-book presentation of human reproduction were heavy-handed, tasteless, and distracting. I was <u>not</u> offended by frank treatment of the subject matter. My trouble in appreciating the presentation was not that I am too sophisticated for materials aimed at teen-agers but that the story was so dressed up that I could not discover the real content.

The attempt to meet the needs of individual students was admirable. Elaborate pains were taken to accomplish this. The individualization made the whole assemblage of material at once a rich opportunity for a student and teacher to assemble a program uniquely valuable and at the same time a baffling mass of material. I think the student and teachers will need help in making the best use of the opportunities these materials present. Recommended sequences to achieve various ends should be developed.

I thought a splendid effort was made to provide feedback to those revising the program. Like the others on the panel, I felt that trial materials were sent out with some specific factual mistakes, but more important, some materials not done well enough in general. It can be assumed that they will be well done in final form but trial materials seemed too hastily written.

Panelist: Mrs. Ruth Ganong

The program deals successfully with a need to add variety and enrichment to high school science curriculum for many types of students. It offers an individualized system for students to look at a tremendous variety of subjects, and seems unique in offering such a broad spectrum of topics. The minicourse format should stimulate interest in many aspects of science, the environment, and social awareness.

I have concerns about the manner in which some of the materials are presented. I am bothered by the "rush to press" procedure. This seems to result in some information that is sent to the students in field tests being inaccurate. Also there are a few rough edges, such as a somewhat insensitive handling of Chapter 8 on human reproduction. However, the management plan provides a mechanism for feedback and correction of inaccurate or inappropriate materials.

Therefore, my overall impression of this program is positive. It is generally well written and informative, and the program is run in such a manner that problems in presentation can be corrected.

Panelist: Mrs. Sarah Hurst

The conceptualization of the ISIS minicourses serves as an admirable example of a "systems" model in education. The model is so well designed that one is almost embarrassed to criticize any specific component or product.

The needs assessment was performed by a prestigious group. The objectives have been identified and reviewed by representatives of appropriate groups. Consideration has been given to many concerns frequently neglected in the development of instructional materials. The reading level of difficulty has been carefully controlled. Relevant topics have been selected. The activities have been designed to ensnare the student's interest. The teachers' manuals anticipate many contingencies.

Praises of the ISIS Project are plentiful, but one part of the system could bear reexamination. When questioned about the haste in preparation of the first draft of these materials, Dr. Burkman indicated that the summer writing conference created the time constraints that lead to a number of errors in these drafts that go to field trial.

The iterative plan of feedback - revision - field trial corrects errors but one may challenge the philosophy that eventual effectiveness is an acceptable value. The content of several units in the field trial stage was considered by several panel members to be trivial and tangential to the objectives. Perhaps the preparation subsystem could be expanded to permit content validation before field trial. What are blatant errors and obsolescent material teaching the students exposed to these field trial units? Science teachers talk to students about accuracy and doing careful work but they don't take the time to validate their own. Is it fair to expect an ordinary secondary school science teacher to be expert in the many discipline areas the minicourses touch so that one teacher can evaluate and guide students past all these errors?

The mechanistic personality chart based on sibling order was proposed in the sixties and was still in one respected textbook published as recently as 1967. This hypothesis of personality development has been rejected by the professional peers of the author. Students exposed to such materials perceive the flaws promptly, as the student member of our panel did. Does such an experience lead to a generalized rejection of social science?

Without belaboring the point further, obviously this panel member does not share the value system of the ISIS Project that speed in production is preferable to more careful research and critique before materials go to field trial. Fewer iterations will be required if more care is given and some activities will be eliminated that are not worthy of the attention of students or the expense of the feedback-revision process.

The contribution of the ISIS minicourses to secondary science education lies as much in the process as the content. Students can become involved. They can participate in setting their goals. They can carry through the ~~activities~~. They evaluate their own performances and then demonstrate their achievement. The system appeals to students who get lost in the usual tangle of verbal concepts. School data indicates there are about three of these students for each "academically oriented" student. ISIS will give this silent majority opportunities to understand many facets of reality that would otherwise remain inexplicable mysteries for them.

The panel was asked to respond to whether the anticipated outcomes of these instructional materials are desirable. From the various points of view represented on the panel, the answer to this question seems consistently "Yes."

Panelist: Dr. Eugen Merzbacher

The ISIS curriculum is strong in conception and somewhat weak in execution. Still, it is my personal view that ~~the~~ project must be given much credit for having come into being at all. I would wish that its quality (not level!) were higher, but I know how difficult it is to organize and render productive such a massive undertaking. Probably, there are financial constraints which inhibit the achievement of the highest scientific and educational standards. I am somewhat concerned that too much administrative activity could threaten to divert attention from the essence of the curriculum, which must be the substance and quality of the materials. For example, long lists of famous scientists on advisory boards are certainly impressive, but one can hardly imagine that the products of ISIS have been inspected, much less approved, by these eminent individuals. However, I believe that ISIS is an excellent initiative and merits continued support.

I feel strongly that the process by which the materials are being produced must be modified in order to assure increased accuracy. It appears that in the rush to get the materials out to the pilot schools insufficient attention is being paid to a proper review by subject field experts. In addition, an independent evaluation of ISIS should be implemented.

Panelist: Dr. Robert A. Peura

I feel that ISIS is an innovative approach which deserves continued support. However, I feel strongly that the process by which the materials are being produced must be modified in order to assure increased accuracy. It appears that in the rush to get the materials out to the pilot schools that insufficient attention is being paid to a proper review by subject field experts. In addition, an independent evaluation of ISIS should be implemented.

Panelist: Mr. Harold Pratt

In my estimation the ISIS materials represent an exciting, much needed addition to the science curriculum available to the high schools. The project provides flexible, individualized modules on a wide range of topics appropriate for use by a wide range of non-science oriented students. By continuing to fund diverse projects such as ISIS the NSF is providing resources which schools can draw upon to assemble their own curriculum. Thus, local autonomy in curriculum development is being enhanced by the development of ISIS materials. I encourage the NSF to continue the support of projects in a modular format. Schools that I am familiar with are requesting more short, module type components to modify and diversify their curriculum. I am hopeful that the ISIS project will influence other NSF proposals and publishers to develop in a similar format.

Panelist: Dr. Leslie W. Trowbridge

This writer views the ISIS program as an exemplary effort in secondary science education. It promises to provide a refreshing alternative to the current mode and structure embodied in the rigid pattern of biology, chemistry, and physics in grades 10, 11, and 12. At the same time it confronts realistically the issue of individualized instruction and presents a workable plan to meet this issue.

Teacher and student choices are increased over the typical opportunities for choice in standard science programs. This may have advantages and disadvantages. For highly qualified and confident teachers, this is an advantage. For others, the large quantity of materials and varied teaching pathways provided by ISIS may introduce confusion.

Any trial curriculum will contain a certain number of errors initially. ISIS is no exception to this. However the mechanisms employed by ISIS to detect substantive errors in the materials are systematic. Adequate safeguards have been incorporated to insure high quality materials for general publication.

The writer looks favorably upon this curriculum development effort and recommends continued support.

Panelist: Mr. Andrew Turner

My general impression of the curriculum is that it is quite favorable in some areas but not in others. In talking to Dr. Burkman (the Project Director) I found out that one of the games ("Use of Energy") had not been successful (the rules had been too long). I think that it would have been a good idea to get a student or students to help design the game, or to model the rules on a game familiar to most students (e.g., Monopoly).

The approaches seem to be well-written, even those parts whose content I am not sure I approve of. In this category goes the "Social Characteristics of Different Kinds of Brothers and Sisters" table in the

"Birth and Growth" section. After checking the characteristics of panelists against those of the chart I found the content to be of about the same value as a horoscope. I think that this kind of thing can be beneficial but it must be presented in the right context (as a sort of a joking, fun exercise, not as something in a serious course of study). Thus its existence in the curriculum is self-defeating. I believe that something like this should come from a teacher or a student on a day when there's nothing else to do (like before a vacation).

As for many of the other projects I think they were very good, especially the weather section.

One complaint I have about the general format, that was partially abated by talking to Dr. Yohe (the Program Manager), was the tremendous amount of stylistic artwork. I believe that it is too juvenile for high school students but I think it will be all right for some of the new markets Dr. Yohe mentioned (primarily younger kids, some in elementary school).

A final point I might raise is about the scientific correctness of the material and the rationale behind it. My colleagues and I spotted several errors [one in the section on pulmonary arrest, another that a sperm's direction in fertilizing the ovum is determined by coriolis force, and a possible misconception about "weighing" air (where several cubic feet of air balance books]. That last is true only in a vacuum, which is not stated in the curriculum.

I believe that a student and his/her parents have the right to expect the material they are given is as correct as the writers and publishers can make it. In talking to Dr. Burkman (the Project Director) I learned that the material is worked on on an experimental basis, with corrections being made as errors are found. I think this is the correct remedy for this situation.

Panelist: Ms. Judith Yero

(No response received)

D. 17. e: ISIS (Panel 6): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

1A. The report on the Callaway Gardens Conference indicates that a diverse group of people knowledgeable about science education concluded that there is an urgent need to redesign the high school science curriculum.

1B. Declining enrollments in high school science courses indicate there is a real need to provide science alternatives to those now in existence. Also, the fact that some teachers are attempting to develop their own materials is further evidence that there is need for alternative programs.

1C. According to the projections made by Ginn & Company, the ISIS materials may be expected to penetrate 22,000 classrooms within a five-year period.

1D. Although there are some minicourses and modules for science courses available, we are not aware of any instructional materials of the scope of ISIS assembled into a unified package.

Question 2: Is there a market for these instructional materials?

2A. We are unaware of any other products which meet the needs of the non-science prone secondary student, and suspect there may be none of the scope of ISIS. Therefore, we support the analysis of the publisher that there may be an adequate market for these materials.

2B. It is the opinion of the panel that ISIS materials can fit into existing curricula in several ways: (1) as a complete science program; (2) as supplementary minicourses for existing programs; (3) as clusters of minicourses within existing programs; and, (4) as resource material supplementary to present courses.

2C. We are encouraged by the Project's interest in training resource people, including classroom teachers, to handle effectively the ISIS materials. Nonetheless, we believe that it would be premature to assess dissemination plans at this time.

As with science teacher training programs in the past, it is anticipated that NSF funds will be available for implementation. The panel is committed to the position that the success of ISIS will be directly related to teacher training and readiness, as well as to the nature of the materials themselves.

2D. There has been a significant free-market response to the need to modularize curricula. Current journals frequently carry advertisements from publishers describing modular materials. Unfortunately, these have been directed to higher education and have not been significantly

manifested in elementary and secondary school journals. It should be noted that a sizeable number of trial schools are purchasing (at production cost) the ISIS materials.

2E. The panel anticipates that the product will become widely used, but that utilization will be influenced by state and local conceptions of secondary school curricula and by adequate in-service training of teachers.

Ginn & Company estimates that some 22,000 classrooms may use ISIS materials over a five-year period.

The panel is unable to assess the reliability of this projection with the information available.

In view of the above, it is our judgment that there will be a substantial market for ISIS materials. A significant impact of these new materials may be to induce a development effort in the private sector to provide other modularized science materials for the secondary school. Our perception is that as ISIS is disseminated and implemented, publishers of more traditional materials will respond creatively in an attempt to secure for themselves a portion of the market. We believe this will have an important beneficial effect on the nature and diversity of secondary school science curricula in the U.S. for years to come.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The purpose and rationale of the ISIS instructional materials are clearly and, for most of the panel members, persuasively stated. A good deal of evidence to support the purpose and rationale is provided on pages 1-7 of the 1972 proposal. Examination of many samples of the instructional materials (Teacher's Manual - Doing Minicourses; Teacher's Handbook - Managing ISIS; Cumulative Objective Coverage by Minicourses) demonstrates that the stated goals and objectives are being fulfilled.

The minicourses which are multidisciplinary can be used to supplement existing science courses in the curriculum. But more importantly a variety of minicourses can be sequenced by the teacher or teachers to meet especially the needs of the great majority of students who are capable yet non-science prone. The instructional materials, if properly utilized by capable teachers, whet the intellectual appetites of non-science students about the human problems in our society where the natural science and social science disciplines interface.

The content of science and the processes of science are incorporated in the materials and into the suggested teaching strategies provided in the teacher's guides. Both the teacher and the learner are placed in learning situations wherein the student engages in self-guided reading, data gathering, and data interpreting while the teacher serves as a catalyst and resource person.

The instructions to teachers and other users should be clearer and more explicit regarding adaptability of the ISIS materials, including ways in which they might be incorporated as a supplement to, or component of, existing high school courses in science.

It is not now sufficiently clear to the panelists how the goal of keeping ISIS materials current and relevant would be accomplished, once they are released commercially. The importance of ISIS in addressing the desires and needs of students for relevance of science topics warrants continuous attention. Revision and updating of ISIS materials must be served by empirical feedback from student, teachers and lay persons.

Question 4: Is the content of these instructional materials scientifically correct?

The panel was confronted with a very large volume of curricular materials which could not be evaluated completely in the time available. We found the trial minicourses and their emphasis by and large to be accurate, but a sampling of the trial materials did show a number of errors, some significant, most trivial.

Examples of the non-trivial follow:

(1) In the Keeping Fit minicourse (p. 41, pp. 46 and 47) illustrations show an incorrect and potentially harmful way to apply pressure bandages.

(2) In the Seeing Colors minicourse illustrations on pp. 10 and 11 are erroneous.

(3) The How Much Energy materials (p. 21) state that strip mined land can be reclaimed for only fifteen cents per acre.

(4) The minicourse Radiation included incorrectly labeled material on p. 4, and the shielding effects shown in Figure 6.1 are inaccurate.

The panel recognizes that these materials are in draft form. We are not aware how far the editing and checking processes have progressed for any of the minicourses. However, we suggest that such errors, which creep into virtually all newly developed instructional materials, be assiduously pursued during the content reviews by specialists before the materials are commercially released. Part of this review process should be done by experts other than those who have participated in writing particular minicourses.

Much of the material in the minicourses begins with simple activities and proceeds to more sophisticated, theoretical concerns. In employing this approach the authors frequently based their minicourses on issues

and problems which are presently being handled in the news media and which are being discussed in non-science high school courses.

The objectives of the core activities and the excursions in these minicourses aim primarily and directly at producing scientifically literate citizens. As opposed to many of the current curriculum development projects (which focus on the best or the poorest students), the ISIS minicourses are directed at the needs of the very large "middle group," especially at those students who are non-science prone.

The flexibility provided by the modular format enables the teacher to tailor the materials to local needs, and the options given to each student within each minicourse provide a desirable means to meet the needs and personal preferences of students as individuals. Both of these levels of adjustment can make these materials more appealing to the student clientele than the more traditional textbooks.

The opportunity for these adjustments and the "offbeat" approach may excite some students who are inclined to shun science to elect additional coursework in science.

There is also provision by way of advanced activities to service students who are already committed to going on to college.

The intent of ISIS is to cover virtually all of the scientific disciplines found in the usual high school curriculum. However, these disciplines are approached through social problems or experiences one does not ordinarily think of in formal, scientific terms. Examples include the chemistry of household detergents and the biological principles behind growing house plants.

For a teacher leading students through an entire year (or more) of ISIS-based instruction, the choice of topics is not imposed by the materials.

The ISIS materials can also be used advantageously as supplements to coursework which is not based primarily on ISIS minicourses.

Question 5: Is the content of these educational materials educationally sound?

5A. Individualized Science Instructional System is a response to the need to design an alternative system that can function totally or supplementary to secondary school science. It will provide interested schools, teachers, students and parents an alternative and flexible form of science teaching and learning. Curriculum materials of the packaged individualized variety represented by ISIS may bring an automatic reaction from those segments of a school community who see the basic traditional school program as being continually eroded by contemporary educational change. Those who favor a structured, sequential approach

to learning will definitely react negatively to a curriculum which they view as scientific smorgasbord. Conversely, those educators and parents more tentative in their search for educational answers will see in ISIS--and other new curriculum programs--an opportunity to enrich their present work. Students may also enjoy the options and contemporary topics of the program, although the premise that students desire choice is neither proven or unproven. Innovative instructional programs like ISIS necessitate in-depth in-service teacher training.

5B. ISIS content and approach are not designed for students who plan a collegiate major in science. Students who plan to major in science can best be prepared at this time by more established programs. A positive factor of these materials, however, is their structure, which capitalizes on prior student experiences as a means of helping them internalize new information and concepts. This process is reinforced further by demanding that students use these new acquisitions in formulating more extensive conclusions concerning both technological and societal problems.

The content/approach of ISIS has the basic challenge of identifying the "terminal" student at the freshman level of high school. Career choices change significantly for a substantial portion of the population between adolescence and young adulthood. The responsibility of American secondary education is to prepare young people in basic skills and knowledge in such a manner as to expand career alternatives. The numbers of seemingly terminal students who later pursue higher education are legion and the American system of educational choice and opportunity allows for this.

Students who opt to complete the minicourses will probably be able to complete the core activities and, more important, have the opportunity to explore freely in a depth of learning that might normally be denied them. The evident danger is that the more able student will select excursions rather than advanced activities. Taken by itself teacher judgment of capability has limited validity, yet the success of motivation for this program would rest jointly with the teacher, student, and parent.

5C. As already noted in the thesis sentence of Question B, the students who desire a solid background in science should have alternative programs available to them in the more traditional areas of biology, chemistry and physics.

Disinterested youngsters may or may not be motivated by the materials. The reason for the disinterest has to be established first. Any student, however, who has a particular in-depth interest might desire to pursue a minicourse in conjunction with a more structured program. This could be the great strength of ISIS: a program in conjunction <u>with</u>, rather than in place <u>of</u> traditional programs.

5D. Affording wide areas of choice permits a school or instructor to avoid topics that they consider sensitive or controversial. More important, however, for those students and/or parents who desire educational exposure to value areas, minicourses permit individuals this exploration.

The overall handling of sensitive materials appears to be satisfactory. It should be noted that restraint and general good taste are particularly advocated in this area. The authors must give great concern to value-laden questions to decrease the possibility of personal bias and to avoid gross comic approaches to the material. The use of the Ginn multi-ethnic criteria should insure avoidance of this type of error.

Constructed on the premise that current traditional science programs in public education were not adequately meeting the needs of all students, ISIS proposes to offer an alternative three-year program of individualized study. The program additionally accepts another premise--that most learning occurs most effectively when choice is involved. Historically, schools have offered a systematic, formalized approach to those learning experiences not easily come by through youthful selection processes. Schools should and must provide the basic tools of learning so that students can respond better to the informal learning experiences of the sandlot, ball parks or general life arena.

There is, therefore, serious question that ISIS, or any other single instructional approach, is completely sound as an alternative science program. Its value, however, as an adjunct and complement to current programs is not questioned, provided the teacher exercises careful judgment in the use of the materials. Educators would be wise to examine these materials and consider them in a supplementary or alternative context.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

6A. These materials, designed to be relevant to non-science prone student's daily living patterns, should be stimulating. A possible result of the use of these materials is increased interest and participation in science studies. A suggested second possible result is a decrease in the high school dropout rate, particularly where science is a required course for graduation. However, caution should be used to assure that there is no de-emphasis on the quality of the program offered to college-bound, science-oriented students.

It is likely that some of the modules, with little or no modification, could be effective with groups other than those now proposed. For example, the units "Heart Attack" and "Cells and Cancer" could be effectively used in a public education, health maintenance program.

6B. The average students should emerge from their science programs with a somewhat greater appreciation for the following aspects of modern science:

1. Problems involving the relationship of science to society.

2. The fact of modern life that while science does have more or less definitive answers to simpler questions, it doesn't usually have "the answer" to more complicated questions of social importance. Typical of the latter are the questions on energy resources and fluorocarbons and the upper atmosphere.

3. Problems and questions on which the students themselves may have an innate curiosity. (Typical examples: Musical Sounds, Seeing Colors, Keeping Fit.)

6C. Some of the greatest unforseen problems could arise through the frequent transfer of students between schools in a mobile society. For example, how would a student trained through one year in an ISIS program transfer credit if he moves into a school system having conventional science curricula? ISIS coursework may not always substitute for traditional science coursework for students planning to enter certain specialized post-high school programs (e.g., nursing). Presumably, the standard coursework would be followed by students going into science or technology areas in college--but introduction of ISIS courses could act to induce the students to examine career choices earlier in their high school career.

6D. Publishers guidelines, by Ginn & Company, should act to minimize such biases or stereotyping. The minicourse Touch the Earth showed diamonds as historically being "girls' best friends" which caused a concern that such a reference could possibly be misinterpreted and therefore create problems of this type. The political ramifications of the materials should also be carefully scrutinized. In sensitive areas, extreme care must be taken to insure that all factual material presented is correct and chosen for proper balance. For example, in the minicourse module Let's Eat, it is no longer true, as illustrated, that DDT costs are partially responsible for high food prices. It is more truthful to say that higher food prices resulted from the fact that DDT use has been barred, and its substitutes are more expensive. In the same minicourse, the inefficiency of plant to animal protein conversion must be modified to include the fact that most of the plant material involved in animal feeding--e.g., grass--is inedible by humans. In general, however, the sampling to which we were exposed indicate a very fair and balanced approach to the issues raised in this sub-question.

6E. The fact that these courses are individualized, of short duration, and contain elements of individual choice may generate an attitude of responsibility in the minds of the students, provided that they are

properly supervised. A thought frequently expressed by the panel is that these minicourses may well strengthen individuals reading ability through the necessity of having to follow the directions for the laboratory portion of the course. On the other hand, the students will probably not exercise their abilities toward the use of library and reference materials, since the minicourses are "packaged with the utmost efficiency."

6F. The panel believes that the detailed results of the actual field tests with teachers and students would be very helpful at the present stage of evaluation. It's difficult to judge whether the level of some of the minicourses is correct without such feedback.

Question 7: <u>Do these instructional materials present implementation problems for the schools?</u>

7A. New curricular programs in all areas stand the greatest chance of success when teachers are prepared to handle them effectively. The ISIS program, taken as a complete secondary science program, is a radical departure for many science teachers. Needed, therefore, would be intensive training in individualized instruction for those teachers interested in modifying or adapting their present science teaching practices to support ISIS's minicourses. The most valuable form of training would be intensive summer workshops of four to eight weeks duration or a planned program of weekly workshops during the school year preceding the first use of ISIS. In addition, reinforcement (periodic workshops) should be provided for teachers during the initial implementation period.

It is to be noted, however, that teachers who elect to use ISIS materials to complement their regular class program would need less extensive training. Each minicourse is sufficiently programmed and detailed to be used with little difficulty in a supplementary manner.

7B. The judicious choice of materials to supplement and enrich current science programs would pose no special problems for schools. A total adoption of the ISIS program, could present faculty, staff, equipment and schedule problems for any school which did not fully explore the ramifications of such a program prior to its adoption. Schools should examine fully how they can best utilize the ISIS materials in terms of the needs of their students and school organization. Whatever entry the materials make into a secondary science program, the effective use of the minicourses should not have to be compromised by faulty teacher or administrative judgment.

7C. Curriculum programs which are composed of consumable components tend to be somewhat more costly over a period of years than programs which utilize hard-cover texts. The purchase of the latter is a long-range program commitment because of increased prices. Lower cost consumable materials have the advantage of being more easily replaced within a shorter time period if they prove to be ineffective.

Generally speaking, costs of new programs tend to be underestimated in the initial planning stages. The flexibility of the ISIS program, however, should allow a system to phase in those modules it deems desirable at a cost factor not overly excessive. A total plunge into this program, as with others, could be both a cost and implementation shock.

7D. Most secondary science teachers should be well enough prepared in science to handle a large number of the proposed minicourses. The inherent danger in the preparation of most teachers is that they are so specialized in one discipline of science that they will have a tendency to propel students towards those minicourses that they (the teachers) find most exciting, thereby negating the free choice objective of the ISIS program. If teachers use the materials in supplementary fashion, this will not be a problem. It would seem, though, that any school system that adopts ISIS totally would benefit from teachers trained more generally in science than specifically in biology, chemistry or physics.

7E. Since the ISIS program itself never assumes to meet the needs of the science-prone student, alternative programs for the science-oriented student must be continued. Not all teachers and students can work effectively in a totally individualized program. Since science teacher preference and differing student learning needs are real school concerns, alternative programs should be made available.

In summary, the degree of difficulty in the implementation of the ISIS materials will depend entirely upon the commitment a school system makes with them. Those systems who select minicourses wisely and thoughtfully, considering teacher, student and parent demands should have little or no difficulty making good use of the materials. The systems, however, which arbitrarily introduce the program could encounter some resentment from segments of the school community.

A district that senses a need for a total program such as that offered by ISIS would be wise to justify that need through parent-student-teacher involvement. Since behavior modification will be needed from all these groups, they should have the opportunity to decide the degree and direction of that modification. Once the initial barrier to the adoption of the program is breached by having all groups express a desire to explore ISIS, then specific aid will be needed, through institutes and/or workshops in the training of teachers. Parent workshops will also prove most beneficial in meeting the overall objectives of the program.

Question 8: Are the costs for implementing these instructional materials reasonable?

8A. We believe that it is not possible to assess adequately the implementation costs within the framework of the data and experience available to the panel. In the first place, comparable materials are not on the market.

Hence costs estimates are necessarily restricted to assessment vis-a-vis noncomparable materials. In the second place, costs will depend on the degree of utilization. Use of ISIS materials to supplement traditional courses presents a set of cost factors quite different from those presented by the use of ISIS materials to replace traditional courses. Since both extremes are likely, as well as many intermediate use levels, implementation cost estimates are problematic, at best. Thirdly, if ISIS succeeds in attracting and retaining student interest in science the increased enrollments can result in additional classes, more laboratories, and a greater number of teachers. These "costs of being successful" are not quantifiable at this time. Finally, if the ISIS program is ~~to~~ be successful, teacher retraining and reorientation programs will be necessary. The cost of such programs can be estimated from past experience but we are not aware that such an estimate has been prepared.

8B. We are not satisfied with the ISIS-Ginn implementation cost estimates. Some of the reasons related to this lack of satisfaction are described above. Additional problems arise with reference to start-up and refill estimates. The proposed start-up costs of $12.90/student traditional programs and $6.30/student with ISIS materials seem to assume a brand new high school in which no pre-existing printed materials are available. In already-established schools start-up costs with the ISIS materials should include the cost of prematurely retiring materials already in use or should present a two to five year phase-in to exhaust materials already in use. In the absence of data on the premature retirement or phase-in of materials we are not satisfied with the estimates presented.

We do not believe the ISIS materials will be handled so gently by students that they will last two years as the refill estimates indicate. The informal nature of the materials will encourage student marking and increase loss as well as casual non-malicious abuse, especially as materials are used outside of class. If they cannot be taken out of class by most of the students using them, the ISIS materials are of limited value. If they can be taken out of class they are unlikely to be usable for two years. In a program completely converted to ISIS, it can be argued that without substantial covers on the minicourses it might not be reasonable to project use by more than one set of students.

8C. There are alternative ways of meeting the needs to which the ISIS materials address themselves. These include freeing sufficient teacher time to generate minicourses locally, increasing the use of field trips and field studies, and infusing the classroom with talented people from "outside" as adjunct faculty. It is our judgment that none of these is likely on a widespread and sustained basis due to the fiscal crunch severely strapping many school districts coupled with the built-in tendency to reinforce the status quo, whatever it is.

8D. We view the societal costs of implementation as negligible if the use of ISIS materials is voluntary at all levels. If their use is imposed by states on unwilling districts or by districts on unwilling teachers or by teachers on unwilling students, the societal costs increase. On the other hand, the societal benefits from widespread and sustained use could be considerable. These benefits could include a more rapid realization of interdisciplinary problem-focused learning situations, the fostering of learner independence, more students attracted to a scientific way of thinking, and an increased level of literacy, scientific and otherwise. Part of the answer to the question of why Johnny can't read is that there isn't much reading materials around school that is of interest to him. We believe that large numbers of high school age "Johnnies" can be interested in the ISIS materials.

8E. Finally, we are committed to the proposition that curriculum development and implementation work must continue to be done somewhere. If implementation costs are problematic, developmental costs are probably prohibitive, in the private sector, at least. Our conclusion is that the Federal Government must continue in their role as a catalyst to foster developmental work and be prepared to assist with implementing particularly in regard to teacher reorientation. It would be very unfortunate in a rapidly evolving world of ever-increasing technological complexity if the Federal Government chose to sit idly by while curricular stagnation spiraled through the land. One result would be to accelerate further the "Future Shock" already afflicting many of our citizens. It is our judgment that if an ISIS-like project didn't already exist, it would be necessary to create one!

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The ISIS project provides for a meaningful amount of predevelopment input from a variety of sources and extensive feedback from students, teachers, and center leaders in both the structured and unstructured modes. The students also respond to the ISIS materials through test results which are analyzed item by item and which have already resulted in demonstrable modifications (to the extent of shelving one minicourse).

The latter action demonstrates not only that this part of the management plan fulfills its function but that the managerial staff is sensitive to this input.

There have likewise been changes in the advisory structure proposed originally in recognition that plans were not working out satisfactorily. By modifying the unwieldly 33-member advisory board into smaller task forces charged with specific jobs, the project leaders have produced what appears to be a more streamlined, efficient arrangement.

Concerns within this panel on failure of the internal monitoring processes to reduce errors in early drafts of the minicourses relate basically to the need for more evaluation for scientific content and for sensitive issues. We understand that time constraints imposed by the Foundation, by the publisher, and by the necessity to provide a working package of minicourses to trial schools no later than September of the trial year prevent the thoroughness in review which the project leaders would prefer. We are also aware that the publisher has supplemented these reviews.

Nevertheless, we recommend that every effort be made to review each revision by more than one competent person and that particularly the pitfall of having only the author search for mistakes be avoided.

National Science Foundation personnel are well informed of the progress of the project by virtue of site visits and through voluminous written material. They receive both draft materials and finished products.

In summary, the management appears sound as an organizational pattern and as a functioning mechanism.

1) Additional comment by Dr. Hilliard Jason:
"In general, the ISIS materials can be considered educationally sound, being based on principles of educational design that are consistent with the recommendations of many of our leading contemporary educational thinkers."

D. 17. f: ISIS (Panel 6): Individual Panelists' Responses to 10th Review Question: What are your general impressions of the curriculum?

Panelist: Dr. Ted F. Andrews

The ISIS Concept

Most of the curricular materials available for the secondary school science teacher are designed for study by groups of students; many of the materials are primarily teacher-centered as opposed to student-centered. The ISIS minicourses are primarily designed for the student. There are teacher's guides and other materials to aid and abet the teacher in assisting the student in guiding his/her own learning. This way of studying and learning should be highly desirable for most students. The student-centered design of the minicourse and the materials for teachers are impressive.

The current high school science courses service best the college bound science prone students. A great number of intelligent students in high schools are not science prone. Most of these students could learn a great deal of science by using the minicourses as an adjunct to or in lieu of some of the existing science courses. The minicourses should provide an alternative science experience for non-science students.

The interdisciplinary (multidisciplinary) nature of the ISIS minicourses is desirable. The non-science prone student is more likely to be interested in topics and issues that to him/her are "real" and related to daily experiences. The minicourses attempt to assist the students in acquiring science information as it relates to topics, issues, and problems that are of special interest to students.

The packaging of student-centered, topic-oriented minicourses that can be accomplished in a few to several weeks is a desirable feature. It should allow students some alternative choices of topics to study without sacrificing his/her learning good science at a pace commensurate with ability.

The instructional objectives in each minicourse are clearly defined both for the student and the teacher. The initial objectives and activities leading to these objectives are relatively uncomplicated. As the student progresses through the minicourse, the activities become increasingly sophisticated. This is a sound approach to learning.

The Minicourses

The titles of the ISIS minicourse trial editions indicate that most are built around socially relevant issues, topics and/or problems. Some deal more with life science (biology) information to be learned, whereas others direct learning more in physical science (physics and chemistry). But all minicourses are multidisciplinary to some extent, a very desirable attribute.

The core, advanced and excursion activities are educationally sound features of the minicourses. The core activities appear to be primarily designed to guide the learning of the non-science prone student. The advanced and excursion activities may better serve the science-oriented and/or very intelligent non-science student. In this reader's opinion greater emphasis should be given to the core and less to other activities in future minicourses.

The recent (revised) format for the minicourses represents a desirable improvement in design. But this reader has reservations about the great use of cartoons and the level of sophistication of the initial activities. Feedback from students and teachers in trial centers should address these concerns.

The social relevance of the minicourses is commendable. Education in the sciences should assist students in evolving a value system. But the structure of the materials and the practices of the teachers should not indoctrinate students with a prescribed value set. The minicourses appear to be relatively free from obvious value bias. Some of the illustrations, as pointed out by Panel #6, suggest a social, economic stance that may be politically unacceptable to serve people. The ISIS staff should be encouraged to have lay persons that are politically alert and concerned examine the minicourses to identify politically sensitive components. The grim editorial guidelines are specific about sexist, racist issues, but are less concerned about political issues.

Resource Materials

The resource units appear to be very useful materials if properly used. The student is frequently guided to a particular resource unit whenever it seems probable he/she might be in need of a particular skill or some background information. This encourages the student to seek information at a time when ready to use it--a logical, sensible process

Materials for Teachers

The ISIS "Teacher's Manual - Doing Minicourses" and "Teacher's Handbook - Managing ISIS" are useful documents to acquaint teachers with the highlights of the ISIS materials and the ways in which students and teachers might use them. The individual Teacher's Guides for each minicourse are also useful in guiding the teacher in her/his role as a catalyst (resource person or facilitator) for a student using student-centered materials that are intended to individualize instruction and learning.

Teacher Preparation

- In the opinion of this writer most high school science teachers will not be capable of using the ISIS materials effectively without special teacher preparation. The teacher preparation should be provided by persons who can demonstrate the role of a teacher who is guiding students

in the use of individualized instructional materials. The ISIS teacher handbooks, guides, and manuals are useful materials for teachers, but are not adequate without advanced special teacher orientation or preparation.

I urge the Foundation, the ISIS staff and the publisher to provide much more teacher preparation than is proposed in the materials I examined: Teacher preparation should continue for several years and should be aimed at meeting problems identified by user-teachers.

Feedback, Review and Revision of Materials

It is understood that time lines and funding place constraints on the ISIS staff. Nevertheless, I would encourage a formalized plan that would involve scientists, teachers, and lay persons, who are socially and politically concerned, in evaluation of trial materials. This could be accomplished at trial school locations and at ISIS headquarters during summer writing conferences.

I sense a great concern and urgency on behalf of the ISIS staff and the publisher to get the materials into commercial editions. I am willing to argue that extension of time lines in order to provide more extensive critiques and more time for rewriting would result in a better product. I'd urge that the pace of production be lessened. The production of a minicourse every 15-20 days is an unreasonable expectation.

Panelist: Dean Elwood B. Ehrle

ISIS fulfills a long-standing need for alternate approaches to science at the high school level. The minicourse format is well designed and executed.

It is a pleasure to indicate my enthusiastic support of the ISIS project and to commend the ISIS staff and the NSF for its development. As indicated in the panel response to question 8--"If an ISIS-like project did not exist, it would be necessary to create one!"

Panelist: Mr. William E. Galbraith

Submitted no comments.

Panelist: Dr. Roger M. Herman

In the memorandum dated November 21, 1975 to the panelists from the project director, Ernest Burkman, it is stated that 15 modules "...have been revised and sent to the publisher for commercial editions." In a second document, "ISIS minicourses as of November, 1975," fifteen modules are marked as "being revised for commercial printing." Of these, at least one (Seeing Colors), contains serious and substantial errors, as

noted in the reply to question #4 of the panelists' evaluation. The minicourse Radiation, which is presently "being revised for further testing," but is presumably included among the modules scheduled for publication prior to June 30, 1976, also contains serious and substantial errors. Since the panel sampled only a few of the modules, there is a serious likelihood that other serious errors exist (not only in the textual materials, but possibly also in the tapes, resource units, etc., which were not carefully checked by this panel) in the materials about to be produced. It cannot be overemphasized that the students and teachers who use the material can be seriously misled by these errors and, at the same time, the credibility of federally funded educational development, and NSF itself, could be seriously and detrimentally jeopardized. Therefore, it is most important to stop the presses until each module is refereed by competent, nonproject-connected individuals who are conversant with the fields being addressed. (As noted in some of the answers, above, such referees may not always be academic in profession or training; in preparing the "Let's Eat" minicourse, it might be helpful to consult a qualified farm expert who is nonacademic, for example.) Possibly NSF may be able to supply a ~~means of~~ reaching a larger pool of such referees who are truly interested in doing such refereeing work, and who, therefore, can be relied upon to perform this service with care and competence.

Panelist: Dr. Hilliard Jason

In general, I am most impressed by the quality of the ISIS program, as both conceptualized and realized, especially considering the tight time constraints under which the materials that we reviewed were produced.

I am very supportive of the premises on which this project is based, and persuaded that it will fill an important need, in an effective way.

I want to emphasize my particular delight with the way in which this project: 1) responds to the indisputable fact that there are wide ranging differences among students, in terms of their areas of interest, rate and style of learning, and personal plans; 2) handles potentially sensitive or controversial materials with intelligence and sensitivity; 3) provides for optimal flexibility in utilization at the local level; 4) responsibly acknowledges the limits of our knowledge and understanding, where appropriate; and 5) strikes an effective balance between attention to the "content" of science and the "process" of scientific thinking.

My only area of serious concern is in the domain of teacher preparation for effective utilization of these materials. An insufficient number of teachers now comprehend the importance of, and the adaptations necessary for use of, individualized, self-paced materials. Without each teacher's individual full commitment to this form of instructional design, or their presentation and utilization of the materials in a competent way, the project cannot approximate its potential. I was not

convinced from the materials we were given to review that the magnitude of the teacher preparation challenge was fully understood by the project designers, and was not in a position to evaluate the actual approaches that will be used in the teacher preparation which they intend to undertake, as it was not described.

One of many possible examples of special problems teachers will face with these materials that are now insufficiently addressed in the documents we reviewed is the issue of student incentives. It is unclear how teachers will be helped to provide incentives for students to undertake those projects and activities in the minicourses which require a fair amount of initiative and effort. Without appropriate strategies and attitudes on the part of the teacher, there would seem to be a high risk that the students would transfer to this program the attitudes that many of them bring to their other courses: that is, an effort to do the least that would enable them to get by. The important opportunities these materials present for providing many students with their first experience in finding joy and satisfaction in the process of learning would be at risk of being missed, without the teacher preparation that could serve to reduce this risk.

A companion to the teacher preparation activities that are needed would be a "promotional" program for administrators, that would serve to help them comprehend the rationale and potential of these approaches. This need, and the possible approaches for fulfilling it, are not adequately discussed in the documents presented for our review.

In sum, it can be said that there is every reason to have a high degree of optimism for the value and impact of this important program.

Panelist: Mrs. Elaine W. Ledbetter

From the first report on the Callaway Gardens Conference, I have been excited about the potential impact of this project. This is my first opportunity to examine ISIS minicourses. Naturally, I have reviewed in considerable detail those in chemistry which is the field I teach. I have also scanned quite a number of other minicourses.

As a whole, I like the content and the approach of these first-draft versions of the material. I can see a real opportunity for expanding the options for high school science students who do not wish to pursue the traditional offerings.

One recommendation I would make to the project staff is to have subject matter specialists, not concerned with the original writing, to review each minicourse very carefully to delete as many inaccuracies and errors as possible. From hearing where the official test sites are located, I am not at all sure that a truly representative group of schools are included. For example, are the materials being field-tested in any rural areas? In inner-city schools? In small towns? To me it seems important that data be collected from as diverse a student population as possible.

Having had considerable experience with individualized instruction in chemistry, I know the tremendous importance of teacher-training. I strongly urge that every effort be made to provide adequate funds for this phase of the ISIS project. Without proper implementation I feel that the time, effort and money that have been spent on this project will be largely wasted.

Panelist: Mr. Kevin McMahon

I have very good impressions of the ISIS curriculum as I feel it will serve as the basis of a two-fold learning experience leading to an awareness of science and society. An awareness which should be the goal of a true education.

The ISIS curriculum is well capable of instructing students in the basic concepts of biology, chemistry, and physics as these concepts are presented in the living situations; the situations the student can identify with. The students are able to intellectually grasp these concepts of science and to understand the relationship of science and their lives; and to make application of this understanding. Application is most important, and immediate application is a most commendable feature of ISIS.

The interfacing of science and society is a theme of the ISIS curriculum. For a people to become aware of this relationship I feel is most important, and ISIS is a starting point. This awareness of science--and science and society--serves as the basis for making important decisions. The decision serving to support the well-being of society; decisions which we are all responsible to make.

I recommend that the project staff review the content of the ISIS mini-courses in order to assure that the social topics are presented in such a way to provide a balance where opinions differ over those topics. The project staff should employ a body of non-project persons for this review and that body be a valid demographic representation.

Such review of student reactions I feel is most important and there is evidence that this has been done. I would hope that the reaction and opinions of students be a prime consideration in any continuing review and revision, if necessary. The student's education is the concern.

I say again that I am impressed with the ISIS curriculum and hope that it will find the support it needs to be available to schools.

Panelist: Mrs. Mary C. O'Brien

The ISIS curriculum, as I see it, has two valuable uses. First, because of the relevancy of its content (material) to the student's ~~daily~~ experiences, it should have drawing power for that large number of students, many of whom have considerable ability, who avoid science

because it is "too hard." Secondly, I see the teacher of chemistry, physics, or whatever, using these as either supplementary or alternate materials--supplementary for the science prone student, alternate for the average or below student who is required to take a unit of science for graduation but finds it hard to cope with present traditional offerings. In addition, I believe that because of the high interest content level, these minicourses will have drawing power even where there is no such requirement and the student has a choice.

In reviewing the list of minicourses available as of November, 1975, I noted a high correlation between the choice of topics and the project objective--relevancy to the student's life and interests. During the work session I examined in some detail four of the modules and found the con~~tent interes~~ting and adequate, as it relates to its purpose. Since I am not a scientist by profession I cannot comment on the accuracy of the content; my positive assessment is based on the high interest level (for the student) of the choice of topics. The illustrations too, for the most part, are germane to the topic, are clear enough for easy interpretation by the student, thereby aiding him in the direction-following process through the courses.

The strength of ISIS is that it lays out an individualized approach to the teaching of science, using the modular format. As I see it, the student who resists being scheduled into a science course will not change unless there is a corresponding curriculum change. The traditional approach looks too formidable. The minicourse topics, addressing themselves to people and things all about them, to the social, political, and human aspects of their lives, may have an appeal. I believe the method is worth trying. There are plus factors for the teacher, too. ISIS may well be the answer to his/her concerns for the non-science prone students. Also, the ISIS materials are well "packaged" coming complete with manuals for teachers and students, a managing manual, tests, charts, games--to be used optionally, depending on the goal.

All science courses have built-in values and these are no exception. The science student searches for the why of things, develops an inquiring mind, and becomes more conscious of the world around him. The minicourses, I think, link the basic laboratory sciences more closely to their counterparts in the field of social and political science. Energy, for example, always of interest to the scientist, has social and political ramifications for all of us living during this critical period in history. There may be an accusation that we are compromising values implicit in "pure" science programs by abbreviating the process and diluting the content, but I believe the competent science teacher can identify those who should take college bound science courses, and can further accept the fact that for some, the modular approach (whether with ISIS or other similar materials) is the only approach.

Worries were expressed about the costs for districts with budget limitations. This, I am sure, is very realistic, but new materials must be purchased eventually, and at this point consideration should be given to a review of ISIS, or like type materials, in the selection process. Marketing should not be a problem if the objectives are clearly understood and the materials are effectively demonstrated. Teacher orientation and in-service preparation are essential.

Unfortunately, we have in our high schools today many students with minimal reading ability. It is my belief that to motivate this large number of pupils toward science, we must make a radical departure from the formal, pedagogical style of teaching science, and adopt a new style and format, combining the use of visuals with the printed word, using "gimmicks" where appropriate, substituting the question or inquiry approach for the introductory statement common to most science textbooks, and above all, speak to the issues that are vital and interesting to today's student. This change is necessary if we wish to bring to the non-science prone student relevant scientific data that he can apply, consciously or unconsciously, to his daily living as he moves about in this complex world.

Panelist: Dr. Marie Parnell

The ISIS curriculum project is a large-scale design which proposes a totally new and comprehensive three-year science program for the non-science prone student in the secondary school. Predicated on a mini-course concept dealing with specific interest topics and tailored to provide individualized instruction and flexible methodology, the program proposes to expand present traditional science programs beyond biology, chemistry, physics and earth science. The project authors are careful to note that current plans and materials are not designed for college-bound students who desire to pursue science as a major field of study.

Strong in a commitment to attract students to science-related topics, the ISIS program will afford teachers the opportunity to develop core programs for that group of learners in a school who have so long been neglected: the so-termed "average student." Existing market materials for this student in the science area are minimal to non-existent. Encouragement, therefore, for the development of new curriculum material for the average student has long been needed in the science field. The variety of new programs available to students through the use of these materials by innovative teachers is unlimited and will serve to augment existing science programs.

Individualized instructional programs meet the needs of a segment of the school population not adaptable to current academic programs. It should be noted, however, that just as traditional programs do not serve the interests of all students, neither do individualized programs. Schools should meet the special learning needs of all students and thereby offer varied instructional programs as well as alternative course electives.

The applied science approach of ISIS extends its use beyond the confines of present-day science offerings. The minicourse in food preservation, for instance, could well be incorporated into a foods and nutrition class and the ones on heart attack and keeping fit might serve more students in prescribed health education classes rather than through elective science offerings. It is this interdisciplinary aspect which broadens the attraction of the program beyond the scope intended by its authors. In fact, the project designers might reconsider their initial objectives.

Although there are many positive aspects to the ISIS program, some concern must be given to insure that the attempt to deal with the relevancy of content for today's student might not build in an obsolescence factor by the time of the program's implementation. This same concern can be expressed in regard to the manner of content preparation. Humor, for instance, tends to outdate very rapidly. Illustrations also date material far more rapidly than written content. The appeal of the wrapping of any package is both instant and brief. The most important part of the package is what it holds. Students know what is in their curricular materials: it's the substance they want to interest them, not the package. Excessive attention to the attractiveness aspect of the ISIS program could, this reviewer feels, impair its effectiveness.

The success of a curriculum and the impact of any classroom strategy depend upon the teachers involved. New programs that represent departures from accepted teaching methods and materials must include the opportunities for intensive teacher preparation. Classroom management problems with a total ISIS program could prove excessive. Funds should, therefore, be allocated for teacher preparation prior to any widespread dissemination of the ISIS materials. It would seem that projects which propose teacher strategies different from the norm build into their proposal initially the costs of teacher preparation, since the materials will be only as effective as the teacher using them.

For a further strengthening of the ISIS program it is recommended that a detailed review of content be executed to minimize to the least possible degree basic content errors. Teachers, parents and students are most critical of materials with overt misinformation. Care should also be given to insure that topics with social and/or political value implications be presented fairly and equally. What may appear insignificant to one geographic sector or affiliated group may be highly offensive to another. The values of programs such as ISIS should not suffer because some value-laden topics can be shown to have been presented with bias. Critiques from this specific point-of-view should be sought from groups most likely to show offense.

In the dissemination of materials emphasis should be given to the supplementary and alternative uses of ISIS materials. This will allow for a more gradual phasing in of the program, thereby minimizing

district cost factors and possible teacher and community reaction. Programs which have been introduced in this manner have tended to last longer and to have greater impact than those that have appeared with promise of instant revolutionary impact. Additional use should be stressed rather than replacement value.

Although the need for science materials aimed at average students has already been noted, the documentation for this type of need should perhaps be more extensive than that noted in the original proposal of this project. A detailed needs assessment with outside review might be considered essential for future proposals. What secondary educators accept as fact might not be accepted as such by the general public.

Curriculum to be effective at the operational level of the schools requires constant evaluation and sensitive adaptation to the expressed needs of its community. Research and development of curriculum, therefore, are great factors in providing both information and materials to allow for these sensitive responses. It is second only to the training of staff. The National Science Foundation should assure both obligations for the discipline it represents.

Panelist: Mr. Albert L. Powers

The "big middle" of our student population has been essentially ignored in prior secondary school science curriculum development projects. ISIS is, therefore, heartily welcomed as a promising effort toward accommodating the needs of many who fall within this category.

There are large numbers of students who can be served best by short, exploratory excursions into a variety of science topics, rather than extensive study of only two or three during their secondary school years. It is for this group that I would recommend these materials.

The wide choice of topics, flexibility in sequence, and minimal demand upon facilities and equipment are positive facets of the program. It is a well accepted premise in learning theory that students internalize material best when they are able to relate it to real personal experiences. The flexibility and context of ISIS maximize the likelihood that this connection will be established.

The strengthening of study skills is an essential goal in the education of all youth. By mandating that each student undergo self-evaluation and goal determination followed by pursuance of a carefully prepared instructional sequence, ISIS may become a significant contributor to this cause. It does fall short, however, in its encouragement of information retrieval skills and strengthening in this regard is strongly urged.

An effective choice of topics and the determination of the depth in which each is pursued require a careful assessment of student interest and ability by student, parent and teacher. This process is commendable for it encourages a level of communication among these parties which is all too often totally lacking. In addition, one would tend to have more

confidence in an assessment made jointly by these parties than in one rendered solely by the teachers.

The validity of individualized instruction is challenged frequently. Too often, this approach is implemented improperly with inadequate materials and management systems. It is not uncommon for this instructional approach to be confused with independent study which involves freeing a student to pursue his own interests. Individualized instruction, as set forth by ISIS, is a highly structured instructional mode with the student at its pivot point.

Proper implementation is a must. At a minimum, this will require the following:

a) Parent/student awareness of the program's format and goals must be developed prior to voluntary enrollment.

b) An ongoing assessment of each student's goal must be conducted and accompanied by adjustments in both the selection of minicourses and the depth in which they are pursued.

c) A well-constructed system must be designed for managing and monitoring both student progress and use of facilities.

d) Thorough teacher training must be provided in the methods, skills and attitudes necessary for the implementation of a), b) and c).

Failure to include any single parameter listed above will seriously jeopardize the value and impact of ISIS. Omission of item d) could deliver a lethal blow to the program.

In addition to the issue of implementation, it is hoped that serious consideration will be given to developing a mechanism for "perpetual" reevaluation, revision or deletion of "old" minicourses and development of new, contemporary materials as the need dictates.

Panelist: Dr. Howard Stein

In reviewing the ISIS project our panel perhaps inevitably expanded some questions to a global scale. It has become obvious to me that this attempt to search for the ideal and, more importantly, to measure the prospects and outcomes of government policy against the ideal has but limited value. We live and operate in the real world in which practical restraints make even approaching the ideal impossible.

As our review gained momentum all of us discovered errors in factual materials, unrealistic expectations, inappropriateness in the organization of the project, and other matters which elicited suspicion and

concern over the project as a concept and over the course of its progress. After a great deal of free-ranging and frank discussion and after uncovering much information from each other, from NSF, and from Dr. Burkman, the panel became aware of explanations which are not all evident on cursory examination of the documentation. To a greater extent than I expected practical restraints channeled events and caused problems which I had believed initially to be attributable to faults of the management and operation of the project.

As a case in point, the demanding calendar which required simultaneously producing many minicourses to meet an absolute deadline resulted in some mistakes which I consider inevitable under the circumstances.

I am particularly heartened by evidence that the project management has modified its modus operandi and even its list of minicourses. This sign of responsiveness to feedback reflects a managerial attitude and sensitivity which is admirable.

There are, however, more errors in the draft materials than I am willing to accept. Therefore, I wish to underscore the panel's recommendation that the process for finding factual errors be strengthened.

Many of the ISIS booklets contain a foreword dated August 1, 1974. Although I do not disagree with its content, I question the wisdom of giving students and possibly parents a statement which flatly accuses the pre-ISIS instructional materials of being inadequate.

The potential use of ISIS materials for adult education is well worth developing. Such development can be encouraged easily by planting the idea in the minds of teachers and school administrators as an addendum to teachers manuals, advertisements, and the like. Overall, I am positively impressed with the ISIS program, and I anticipate a considerable degree of success.

Panelist: Dr. Roger K. Wangen

As a kindergarten through four-year undergraduate state-wide social studies specialist, one of my primary roles is to meet the curricular needs of 20,000 social studies teachers in Minnesota. Individualized Science Instructional System (ISIS) is an alternative that will be widely received by teachers who are attempting to meet the individual diverse needs of their students and parents. Schools that offer only single means to educational ends can't meet the needs of diverse learners.

The exciting dimensions of the ISIS materials can meet individual and societal needs not previously attempted by curricular developers. This design will improve the science literacy of noncollegiate science majors who in many cases do not study high school science. The 50 minicourses (two to three weeks long) will increase the student science interest and promote more taking of risks than previous year long formal courses provided.

The design includes core assignments for all to accomplish followed by excursion activities for some and advanced activities for others. These advanced activities allow the noncollegiate science major to attempt to accomplish these advanced activities and actually gather data as to whether he or she is capable of collegiate science achievement. This is really innovative.

The ISIS materials will introduce and reinforce basic study skills that will make great contributions for general literacy. The skills of identifying, clarifying, and stating a problem and identifying alternative solutions is a major skill needed by citizens in our dynamic democratic society. The skills of gathering, organizing, evaluating, and reporting information for purposes of clarifying issues and solving problems is ever present in the materials and will make an important contribution to general literacy.

The diversity of important topics that in many cases reflect global conflict is a real strength of ISIS. Improving awareness of national and global problems will assist in present and future citizen decision making.

The opportunity for students to self-pace will enable students to develop and practice the skills of self-motivation, self-direction, and self-control.

ISIS materials will contribute to the global need for humankind to identify and clarify values which can then serve as criteria for evaluating one's behaviors for congruence and when incongruities are identified plans for correction are designed, implemented, and evaluated.

In conclusion, I think Congress has a responsibility to meet the national educational needs that local educational agencies, state agencies, higher educational agencies and publishers have demonstrated inability to meet.

I concur with the recommendation I of the "Report of the Science Curriculum Implementation Review Group to the Chairman, Committee on Science and Technology, U.S. House of Representatives, October 1, 1975" which recommended "...that the NSF continue pre-college science curriculum activities...."

D. 18. a: BICP: NSF Descriptive Information

PROJECT TITLE: The Biomedical Interdisciplinary Curriculum Project (BICP)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Dr. Leonard A. Hughes

INSTITUTION: California Committee on Regional Medical Programs

BUDGET: Total Granted: $1,587,359

Dates: 4/1/72 - Present

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: BICP is developing an interdisciplinary two-year curriculum for 11th and 12th grade students of average ability and above to motivate and prepare them for entry into a variety of post-secondary programs leading to future careers in the medical and health-care fields.

PROJECT SUMMARY

BICP's continuing objective has been the development of a specialized, two-year curriculum for the junior and senior years of high school. The major purpose of this curriculum is to prepare and motivate students for entry into any one of a variety of programs beyond high school that would eventually lead to careers in the health-care field. Throughout the curriculum, students are made aware of health-career opportunities, the paths of entry into these careers and the skills and responsibilities associated with them.

DESCRIPTION:

The curriculum is designed to occupy four classroom periods each day for the full two years. Two of these periods are devoted to biomedical science, one to mathematics and one to social science. Thus, three teachers are involved, with each teaching his own specialty; but because of an interdisciplinary emphasis built into the curriculum, teachers must also be committed to drawing upon and supporting common educational goals. Many interdisciplinary activities are specified and elaborated within the program and call for coordination among teachers if the goals are to be met. In addition to this interdisciplinary aspect, a special effort has been made to stress the application of skills and concepts and, in this application, to utilize exemplary material from the field of health and medicine wherever possible.

The Bioscience Course

Within the bioscience course, basic concepts in chemistry, physics and physiology are presented in the context of health and medical problems.

Students become involved in the investigation of fundamental physiological and biochemical processes. Additionally, they are exposed to procedures drawn from laboratory and clinical medicine as well as to concepts and procedures in computer science. An important goal of the science course is to let the laboratory activity carry the burden of teaching by actively involving the students. The Biomedical Instrumentation Package (BIP), to be described later, plays an important role in giving the student an opportunity to participate in laboratory work that under most conditions would be presented only as a demonstration in a high school laboratory, or would not be presented at all.

The Mathematics Course

The math portion of the curriculum approximates the standard college-prep program in that it devotes attention to linear, quadratic, exponential and trigonometric functions. Significant attention is also given to such topics as error analysis, statistics, symbolic logic, dimensional algebra and linear programming.

As in the science course, perhaps the most important way in which this course differs from standard courses is in its emphasis on applied problems. Most problems are drawn from the various areas of science. In addition, a significant portion of the course is devoted to the analysis and generalization of data collected by the students in the science laboratory. On an interdisciplinary level, for example, the development in math of symbolic logic is subsequently applied when students become involved in the logic of computer operation in the science laboratory.

The Social Science Course

The social science course complements bioscience by giving students the opportunity to explore the societal and cultural dimensions of health, disease and health-care delivery. A basic objective of this course is to equip students with the tools for analyzing and understanding the ways in which a sociocultural system can both directly and more subtly affect the health status of those within its domain of influence.

Students are exposed to selected concepts and skills drawn from a variety of traditional disciplines--sociology, anthropology, political science, etc. They then apply these to health-related social problems. For example, they examine nutritional practices (and their effects) as they are determined and perpetuated by systems of beliefs and values, i.e., cultures. And, on the interdisciplinary level, a social analysis of dietary practices is complemented by nutritional studies being carried out simultaneously in the science lab.

UTILIZATION

In the fall of 1975, a high school in the Oakland, California school system will begin teaching the revised version of the curriculum on a demonstration basis. At this school and at project headquarters in Berkeley, will be offered workshops for potential users of the curriculum and for those who are in a positon to introduce it to others.

Also beginning in the fall of 1975, the revised version of the curriculum will be taught in eight to ten high schools in the Detroit, Michigan school system.

HISTORY

BICP Was conceived in recognition of a well-documented critical health and manpower shortage that exists today and is expected to exist into the foreseeable future. This national problem was pointed out initially in the 1967-68 Carnegie Study on health manpower needs. The BICP goal is to develop an eleventh and twelfth grade curriculum which will motivate and prepare students for entry into various higher education programs relating to careers in medical and health fields.

PERSONNEL:

Dr. Leonard Hughes, Project Director
Dr. Ronald Linder, Project Coordinator
Glenn Housh, Editorial Coordinator
Dr. Allen Vegotsky, Coordinator, Science Curriculum Development
Michael Weiner, Associate, Science Curriculum Development
Glenna Gerard, Assistant, Science Curriculum Development
Robert Ziegler, Supplies & Lab Manager/Writing Assistant
John Hanshew, Coordinator, Mathematics Curriculum Development
Dr. Richard Eckel, Associate, Mathematics Curriculum Developmnet
Dr. William Hering, Jr., Coordinator, Social Science Curriculum Development
Arnold Seibel, Associate, Social Science Curriculum Development

D. 18. b: BICP (Panels 4 and 5): Project Director's Response to 10 Review Questions

NSF Staff Note: The project director for the Biomedical Interdisciplinary Curriculum Project responded in the somewhat different format below.

INTRODUCTION

This statement includes material written for the use of panelists who will be reviewing the Biomedical Interdisciplinary Curriculum Project (BICP). Therefore, section headings correspond to similar headings included in the set of ten questions assigned the panels by the NSF. This statement is not intended to be an apologia for the curriculum materials produced by BICP; we know that those materials ought to be judged by their own merits. It is intended to supplement those materials by providing panelists with knowledge we have gained as a result of the development process, and to offer our impressions with regard to the questions raised by the Foundation.

NEED, RATIONALE, AND PURPOSE

Health encompasses a dynamic network of interrelated life systems. It can be defined and promoted only by integrating the views of many disciplines. The World Health Organization has redefined health as "not merely the absence of disease and infirmity, but the complete social, physical and mental well-being of the individual." At the time this new definition was adopted, optimal health appeared attainable through the contributions of science and technology. Unfortunately, this hope was premature. Rather than approaching "complete...well-being" we are currently experiencing a resurgence of several diseases of the past and adding to a growing list of new health problems. Many current health problems result from inappropriate applications of science and technology; others are consequences of social conditions, such as the rapidity of culture change to which we are now trying desperately to adjust. Moreover, the measures needed to both ameliorate long-standing health problems and prevent new ones are often pre-empted by conflicting values and actions providing short-term material gains at the expense of long-term human loss.

We all have a vote in shaping the future world. If that world is to be healthy, we must equip our future decision-makers to foresee the impact of applied science and technology on humanity and to realize the limitations of science and technology as sources of solutions for human problems. A commitment to values which support an interdisciplinary view of man and his environment is essential to attaining an ecological balance and to achieving optimal levels of health.

Commensurate with those values intrinsic to the Biomedical Curriculum which supports an interdisciplinary view of man and his environment is the long-range cost benefit of the BICP to the Federal Government and the American people. Increasing demands for health manpower and gainful employment are highly compatible current national priorities. In a time

of widespread economic hardship, it is imperative that we support those educational programs which offer a viable alternative to educating people for job markets that may not exist.

From all indications, the health manpower shortage will continue to grow in the foreseeable future. Health care now accounts for nearly eight per cent of the gross national product as compared with only four per cent fifteen years ago. In 1970, there were 4.4 million workers in the health field. In 1980, this figure is projected to be approximately 6.4 million. The health care work force is increasing by a yearly rate of 200,000, which does not reflect the number of new personnel required each year to replace those who retire or leave the field for other reasons.

The BICP materials are being developed as a response to the need for a holistic view of health, the critical shortage of health manpower, the growing requirement for health information, and the necessity to bridge the potential conflict of technology and humanity. BICP materials are intended to help future health professionals successfully encounter issues critical to improving the quality of life through better health. These issues are not solely the concern of health care workers, and the BICP materials are written with that fact in mind. A student who completes the Biomedical Curriculum in high school will probably enter a college or vocational program leading to a career in health. Those who do not pursue a health related career goal will still have the advantage of an interdisciplinary experience that should be of use in any other vocational pursuit.

What is the specific nature of that interdisciplinary experience? There are two basic types of interdisciplinary curriculum: the problem or topic centered approach, in which knowledge and skills from several disciplines are brought to bear upon a single topic or problem of concern and the subject matter centered approach in which several disciplines are studied--not necessarily at the same time--and then related to a particular topic. Because the BICP Curriculum consists of three separate courses, each type of interdisciplinary study is included.

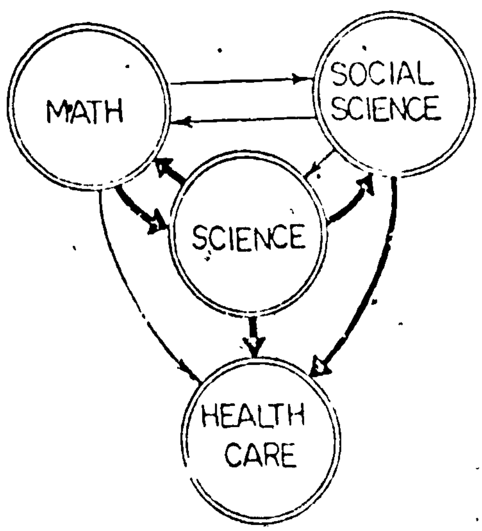
Students are enrolled in three courses (two periods of science and one each of math and social science). Within each of these courses a topic-centered approach is used. In social science, for example, students do not study sociology, or political science, or economics. They study topics which vary in the degree to which they draw upon knowledge from these and other disciplines for understanding. The same is true of the science and math courses.

Between the three courses the approach is more often subject-centered. Students study the same general topic, such as population and genetics, in more than one course. For example, in Unit II of science they learn to conduct an analysis of diets; in Unit II of social science they evaluate the diets of selected cultures they are studying; and in Unit II of mathematics they learn linear programming to get the most from their nutritional dollars.

The grounds for a topic-centered approach (bringing the knowledge of several disciplines to bear upon a single topic at one time) are well known. Important topics are seldom understandable from the perspective of a single discipline. This is a compelling argument, but BICP does not restrict itself to this approach for other, equally compelling reasons. Because students are enrolled in three courses, they have three instructors. Few social science teachers are able to instruct in science or math, and vice-versa. The structure of the school and the exigencies of budgets seldom allow one aggregate of thirty students to have access to three teachers for four hours (at the expense of other students in the school). And because school schedules are subject to daily changes, it is difficult to insure that three teachers will be able to maintain an exact, day-by-day schedule. Therefore, teachers are not expected to maintain a topic-centered approach throughout the curriculum.

We hope panelists will keep this in mind as they review the materials. We have attempted to effect an interdisciplinary approach while allowing for the more typical school schedule demands to intervene. The materials are presented as three separate yet interrelated courses. Each course is intended to be taught over a two year period, usually the eleventh and twelfth grades of a student's education. Each course has its own structure, and each course has relationships with other courses. The relationships are dissimilar in emphasis. (See "The BICP Model" below.)

The BICP Model



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COURSE CONTENT

The various fields of study contained within each separate course are indicated in Tables II, IV; and VI. Unit titles for each course (which provide some clues as to course content) are included in Tables I, III, and V.

BIOMEDICAL MATHEMATICS

TABLE I: UNIT TITLES

Unit No.	Unit Title
YEAR ONE	
I	Measurement, Linear Functions and Dimensional Algebra
II	Uncertainty, Vectors and Chi Square
III	Theoretical and Applied Quadratics
YEAR TWO	
IV	Symbolic Logic
V	Trigonometry
VI	The Binomial Theorem and Genetics
VII	Introduction to Differential Calculus
VIII	Exponents and Logarithms

The uniqueness of the biomedical mathematics course lies less in the concepts presented than in its approach to the subject matter. Traditional mathematical skills are developed throughout the curriculum by means of specific biomedical applications. Lesson sequences both parallel the content of the science course and maintain their own integrity in the development of mathematical concepts, progressing from the simple to the complex. Course content is similar to the standard eleventh- and twelfth-grade college preparatory mathematics courses in its coverage of linear, quadratic, exponential and trigonometric functions but is not as comprehensive in its coverage. Content areas such as error analysis and statistics not traditionally taught in high school mathematics programs are also included. Traditional mathematics problems seldom encountered outside the classroom (e.g., "If Jay is twice as old as Jon, but only half as...") are replaced by practical health problems. Students are not only more receptive to learning new mathematical techniques for which there are practical applications but their ability to recall them is equally improved.

TABLE II: PERCENT OF SUBJECT FIELD CONTENT IN BIOMEDICAL MATHEMATICS

Subject Field	Percent
Linear Functions	17%
Trigonometric Functions	12%
Statistics	11%
Quadratic Functions	10%
Binomial Theorem	9%
Exponents and Logarithms	8%
Vectors	8%
Measurement and Error	8%
Differential Calculus	7%
Complex Numbers	3%
Symbolic Logic	3%
Miscellaneous	3%

BIOMEDICAL SCIENCE

The biomedical science course contributes a broad range of health problems and issues (e.g., trauma, lung disease, drug abuse and malnutrition) appropriate for mathematical applications. The mathematics course reciprocates by equipping students with the mathematical skills essential to success in the science course. The most obvious interdisciplinary contributions of the mathematics course are to the science course, whereas ties such as in chi square between the mathematics course and the social science course are more subtle.

In the science curriculum, human anatomy and physiology (20%) provide a framework of physiological systems which ties the course together (see Table IV). Although the unit titles appear to be exclusively physiological, the actual content is far more comprehensive. In each unit, the health and medical aspects of a topic are given extensive consideration with appropriate treatment of related chemical and physical concepts. Through the extensive use of laboratory activities, stress is placed on learning-by-doing. The theoretical concepts of many disciplines are applied in laboratory exercises that touch upon personal and community health problems. Many of these exercises simulate the work of certain health professionals.

TABLE III: UNIT TITLES AND COURSE CONTENT OF BIOMEDICAL SCIENCE

Unit No.	Unit Title	Course Content
YEAR ONE		
I	Respiration in Health and Medicine	Anatomy, physiology and pathology of the respiratory system; the behavior of gases; introductory chemistry; air pollution.
II	Nutrition in Health and Medicine	Anatomy, physiology and pathology of the digestive system; chemistry and biochemistry of foods; dietary deficiencies; energy storage and utilization; the optimal diet; dental health and disease.
III	The Transport System	Anatomy, physiology and pathology of the circulatory and excretory systems; the blood vessels, the blood, and the immune system; some fundamentals of electricity.
YEAR TWO		
IV	Sensory Systems	Anatomy, physiology and pathology of the sensory systems; introduction to the physics of sound and light; introduction to computer activities.
V	1. The Central Nervous System	Anatomy, physiology and pathology of the central nervous system; more computer science.
	2. Pharmacology	Selection and application of drugs, habituation and addiction; placebo effect.
VI	Trauma and the Musculoskeletal System	Anatomy, physiology and pathology of the musculoskeletal system; Newtonian physics as related to accidents and trauma, effect of trauma on the musculoskeletal system.
VII	Reproduction and Genetics	Anatomy, physiology and pathology of the reproductive system; cell division; gestation; birth defects; regulation of family size; venereal disease; human genetics, molecular biology; natural selection; populations
VIII	Patterns of Disease and Ways of Life	Investigation of selected health topics by career interests with broad interdisciplinary applications.

TABLE VI: PERCENT OF SUBJECT FIELD CONTENT IN BIOMEDICAL SCIENCE

Subject Field	Percent
Anatomy and Physiology	20%
Laboratory Medicine	14%
Physics	12%
General Chemistry	11%
Biochemistry	10%
Clinical Medicine	10%
General Organic Chemistry	7%
Computer Science	6%
General Biology	5%
Miscellaneous	5%

BIOMEDICAL SOCIAL SCIENCE

The biomedical social science course emphasizes process over content and inquiry in place of didactic instruction. Students are taught a variety of concepts and skills drawn from several of the social sciences that are particularly useful in dealing with the social, psychological and humanistic implications of relevant health problems and issues.

TABLE V: UNIT TITLES AND COURSE CONTENT OF BIOMEDICAL SOCIAL SCIENCE

Unit No.	Unit Title	Course Content
YEAR ONE		
I	Health and Society: Basic Social Science Inquiry into Health-Related Problems	Dimensions of health; levels of analysis; points of view; methods of inquiry.
II	Health, Culture and Environment	Ethnocentrism; cross-cultural analyses; culture and nutrition; culture and health.
III	Introduction to Political Decision-Making	Political decision-making in formal and informal organizations; goal conflicts and decision-making; the legislative process.
YEAR TWO		
IV	What Affects Human Behavior?	Value clarification, attitude formation, small groups; social norms.
V	Allocation of Health Resources	Societal institutions; health-care systems and the individual; alternative health-care systems; economic dimensions of resource allocation.
VI	Intellectual Development	Cognitive growth and moral development.
VII	Population Growth and Genetics	National and global perspectives on population growth; factors influencing population growth; genetic engineering; genetic counseling.
VIII	The Future of Health Delivery	Epidemiology, social consequences of development in health-care delivery; citizen participation in affecting health-care delivery.

Political science (20%) and sociology (20%) are the fields of study that contribute the greatest amount of content to the social science course (see Table VI). The curriculum focuses on current health problems (e.g., coronary heart disease, malnutrition and drug addiction) which require for their solution an understanding of the individual and his relationship to the social milieu in addition to basic science. Among the many problem-solving resources provided, students are taught the fundamentals of research methodology (sampling, questionnaire construction, participant observation and reporting), political efficacy (identifying problem areas and applying proposed actions), and value clarification.

In short, the social science course presents a large body of knowledge that is essential to health professionals and community decision-makers in the prevention and treatment of disease.

TABLE VI: PERCENT OF SUBJECT FIELD CONTENT IN BIOMEDICAL SOCIAL SCIENCE

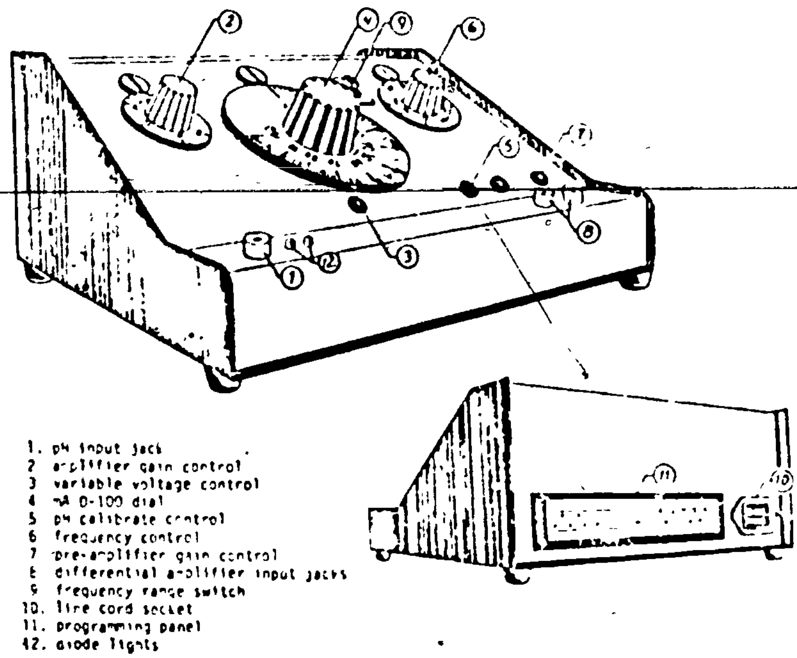
Subject Field	Percent
Political Science	20%
Sociology	20%
Anthropology	15%
Economics	15%
Methodology	10%
Social Psychology	10%
Epistemology	5%
Psychology	5%

In each of the three courses, students are confronted with health-related problems that require interdisciplinary solutions. These interdisciplinary learning experiences should prove invaluable to students as members of a rapidly changing society and as future health-care professionals.

The BIOMEDICAL INSTRUMENTATION PACKAGE (BIP)

The BIP is an integral part of the Biomedical Curriculum. It is a low-cost, versatile, rugged electronic device developed to provide a wide range of laboratory measurements relevant to understanding sound, electricity and bioelectric phenomena. Also, it is used to perform such measurements as current, voltage, resistance, temperature and pH. Among the BIP applications are electrocardiography, electroencephalography, colorimetry, turbidimetry, sine waves, square waves, hearing testing, electrophoresis, electroplating and computer science. The BIP has made it possible to implement laboratory sequences heretofore not accessible to most high schools because of prohibitive costs and the lack of suitable equipment. (See the BIP diagram on the following page.)

The BHP



THE BIOMEDICAL PRACTICUM

A major goal of the Biomedical Curriculum is to acquaint students with a variety of health careers. In addition, a Biomedical Summer Practicum has been designed to provide a learning-by-doing introduction to a variety of health careers and health-care settings. Students apply skills acquired in the classroom and laboratory to actual work tasks within career situations. From these experiences, the intellectual and emotional demands of a particular health career become apparent to the students. They spend five weeks on the job with health-care practitioners and two weeks in orientation and follow-up activities. One week is devoted to each of three student-selected health careers and two weeks to the career of greatest interest to them. A daily journal of work experiences is maintained by all practicum students. The journal entries are important sources of discussion during weekly group meetings. For each of their career trials, students receive training requirements, working conditions, salary ranges and job descriptions. Students are assigned to a health practitioner who acts as their supervisor-teacher while the Biomedical teacher assumes the role of "roving facilitator," through weekly career site visits and group discussions.

An evaluation of the trial practicum, conducted by our health careers co-ordinator, in three Bay Area high schools during the summer of 1974 produced highly favorable results. A Biomedical Practicum Guide is being developed to assist teachers in providing such meaningful career experiences for their students.

EDUCATIONAL SOUNDNESS AND SCIENTIFIC ACCURACY

The best test of educational soundness is found in the degree to which the materials are successful as a preparation for the future and the degree to which they are accepted by students and teachers. By examining the materials, panelists will be able to evaluate, based upon their own experience, the pedagogical quality of the materials. We have spent considerable time and effort in developing materials that are appropriate for eleventh- and twelfth-grade students. The instructor's manual that accompanies each unit will provide panelists with examples of how the materials have been structured to be of inherent interest and teachability. Staff writers have considerable teaching experience, and they have been fortunate in the degree to which they have had access to feedback from teachers who are using the materials. This process of teacher feedback is continuing, and four Biomedical teachers are part-time members of the staff. The nature of responses we have had from students and teachers supports the educational soundness and scientific accuracy of the curriculum.

In order to help insure accuracy, the writing staff has sought the advice of consultants at many points in the development of the materials. The writing staff of each course includes a Ph.D. in a subject field, the director of the project is a physician, and the project coordinator is a health educator. These persons meet regularly (at least once a week) to review all materials produced before they are released to schools. Nevertheless, inaccurate statements or presentations may still be present in certain parts of the curriculum. The best test of scientific accuracy lies with critical examination of the materials by panelists knowledgeable in the subject areas.

IMPLEMENTATION AND MARKETING

The Biomedical Curriculum assumes four class periods each day for two school years. Due to the abundance of laboratory activities, biomedical science occupies two class periods, whereas mathematics and social science each meet for one class period daily. Variations of this theme are possible. Some school administrators have elected to offer one and a half years of social science to enable their students to take other courses. Other educators have combined the mathematics and science courses in a three-hour block and used a team teaching approach.

A successful two-year field trial of the BICP package in six California high schools was completed during June 1975. These trial experiences provided feedback essential for revision of the curriculum, which is currently being implemented in seven Detroit public high schools and eight California high schools.

Marketing a new curriculum package such as ours is contingent, in part, upon prior implementation. Following the curtailment of NSF implementation funds for 1976, we developed a contingency implementation plan.

TABLE VII

Current and Projected Biomedical Courses
by State/City and School

State/City	School	Number of Schools Teaching Biomed Curriculum		
		Fall 1975 (Current)	Fall 1976 (Projected)	Total
ARIZONA				
Tempe	*		1-2	1-2
ARKANSAS	(Health education pilot program)		5-10	5-10
CALIFORNIA				
Albany	Albany High School		1	1
Concord	Mt. Diablo High School		1	1
Davis	*		1-4	1-4
Fremont	American High School	1		1
Fresno	Fresno High School	1		1
La Mesa	Helix High School	1	1	2
Los Angeles	*		6-12	6-12
Newport Beach	Newport Harbor High School	2		2
Oakland	Oakland High School	1		1
Palo Alto	*		1-2	1-2
Petaluma	Petaluma High School	1		1
Pleasant Hill	College Park High School	1		1
Sacramento	*		2	2
San Diego	San Diego High School		1	1
San Francisco	*		1-2	1-2
San Jose	*		4-6	4-6
San Mateo	Sequoia High School		1	1
Santa Rosa	Santa Rosa High School		1-2	1-2
Travis AF Base	Travis School District		1	1
HAWAII				
Honolulu	*		1-2	1-2
INDIANA				
Indianapolis	Howe High School		1	1
	*		1-2	1-2
MICHIGAN				
Detroit	Cody, Martin Luther King, Chadsey, Southeastern, Cooley, Northwestern, Western	7		7
MISSOURI				
Kansas City	*		2-3	2-3
MINNESOTA				
Minneapolis	*		1-2	1-2
NORTH CAROLINA				
Raleigh	*		1-3	1-3
OREGON				
Portland	*		2-5	2-5
TEXAS				
San Antonio	*		2-3	2-3
WASHINGTON				
Olympia	*		1-2	1-2
Seattle	*		2-4	2-4
Tacoma	*		1-2	1-2
OTHERS	(Including Northern Calif.)		10-15	10-15
TOTALS		15	53-92	68-107

* = Undetermined

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The plan is both simple and ambitious. The goal is to have at least fifty Biomedical Programs in operation, primarily on the West Coast of the United States, by Fall 1976. (See Table VII, Current and Projected Biomedical Courses by State/City and School.) Since we built into the curriculum package a set of instructor's manuals, the pre-service and in-service training requirements for implementation are minimal. In fact, three California high schools accomplished a successful self-directed implementation with merely one day of orientation from our staff. Therefore, we believe our current implementation goal is possible by carefully expending our limited implementation resources over the next year. Although theoretically not the most educationally sound approach, the results are excellent thus far for such a small investment.

Although the suspension of the BICP national implementation plan did indeed adversely affect the interests of several of our twenty university representatives throughout the country, we continue to receive enthusiastic support. Several prospective dissemination and implementation center applicants (Arkansas, Missouri, Arizona, Teaxas, Indiana and North Carolina) are seeking alternate funding to implement the Biomedical Curriculum. For example, educators in North Carolina and Arkansas are interested in a statewide implementation effort funded by local private and public funds.

To maximize our limited resources for outreach activities, educators throughout the United States will have an opportunity to review the Biomedical Curriculum by attending one of three informational workshops, which will be held in Oakland during the Spring of 1976. The Oakland High School BICP demonstration site will provide an opportunity for observations and discussions related to all aspects of the curriculum with students, teachers and administrators.

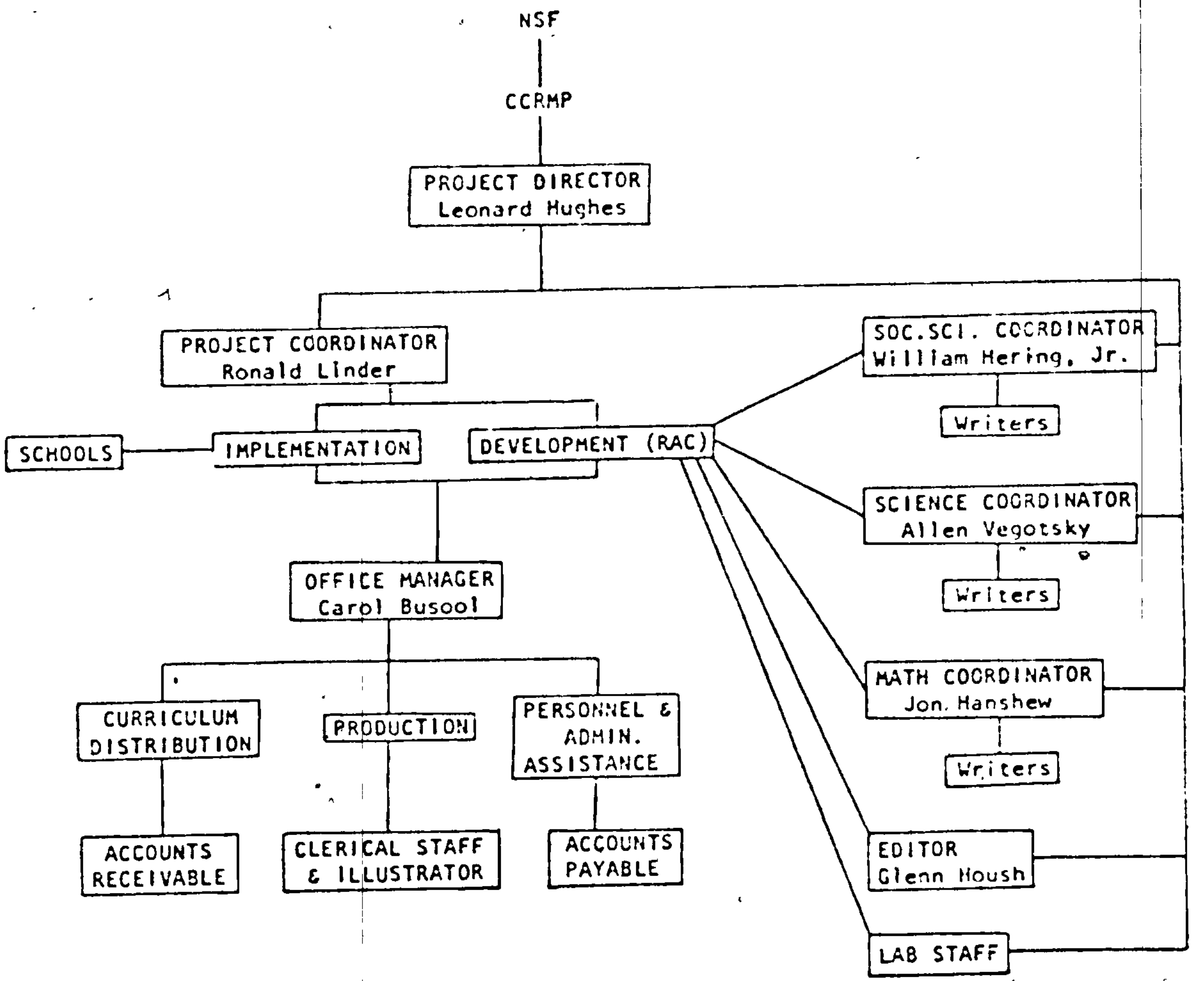
By developing an implementation manual and establishing a market base of fifty Biomedical Courses by Fall 1976, our ability to acquire a publisher among the following interested houses should be enhanced:

Addison-Wesley Publishing Company
Benziger, Bruce and Glencoe, Inc.
Bobbs-Merrill Company
W. H. Freeman & Company
Harper & Row, Publishers, Inc.
D. C. Heath and Company
Houghton Mifflin Company
Learning Realities, Inc.
Random House, Inc.
W. B. Saunders Company
Westinghouse Learning Corporation

A proposal was being developed to evaluate the entire BICP in conjunction with our aborted national implementation effort. In the absence of supportive data obtained through a prescribed evaluation design, we strongly recommend that an independent comprehensive evaluation of the BICP be conducted in the near future. Nevertheless, 85 percent of those students in seven high schools who completed the initial two-year trial of the curriculum are currently attending colleges or universities.

TABLE VIII: THE BIOMEDICAL INTERDISCIPLINARY CURRICULUM PROJECT

Organizational Chart



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MANAGEMENT AND ORGANIZATION

Table VIII represents the current organizational structure of the BICP, which is administered by the California Committee on Regional Medical Programs. The primary mission of the project at this time is to revise the trial curriculum. Prior to establishing the Revision Advisory Committee (RAC), a series of assessment meetings were held in the late spring of 1975 to evaluate the trial package and obtain suggestions for revision and further implementation. In advance of the scheduled meetings, the teacher teams (math, science and social science) in each of the high schools prepared a position paper on their two-year BICP trial experiences. Also, questionnaires were disseminated to all trial teachers and their students to evaluate specific parts of the two-year curriculum package. Our staff received copies of the position papers and the results of the questionnaires prior to the meetings so that a more detailed analysis of the results could be accomplished.

Students' questionnaire responses often reflected their teachers' attitudes, which were generally favorable, notwithstanding many suggestions for improving the curriculum. A recurrent statement made by the teachers throughout each of the evaluation meetings was that teamwork is an important ingredient to a successful Biomedical Program. One of our mathematics teachers said, "The real educational significance of the Biomedical Curriculum is that it simply teaches students how to solve problems. If you put a class of Biomedical students in one room and a class of other students in another room with the same problem to solve, the Biomedical class will solve it much faster." Detailed guidelines for revising the trial version of the curriculum were generated by the questionnaire results, the position papers, and our meetings with the trial teachers and selected publishing representatives.

The BICP revision process (see Table IX) was established to apply those guidelines generated from accumulated reports over the two-year trial and the final assessment meetings. A critical component of the process is the Revision Advisory Committee (RAC), composed of key persons within the curriculum development and implementation phase of the project.

The process has proved successful in providing a systematic plan of improved curriculum, which is being revised in a true interdisciplinary manner.

COST OF THE BICP PACKAGE

The cost of a new curriculum is an increasingly important consideration for educational dicision-makers. Nevertheless, the total benefits of new curricula to the students and the community are equally important in the decision-making process.

All instructional materials, including texts, BIP's, computer components and laboratory supplies for thirty students over a six-year period will range from $23 to $26 per student year for all three courses (see Table X).

With two Biomedical Courses of thirty students each in the same school, one beginning in the first year and the other in the second year, whereby hardware can be easily shared, the cost can be reduced to $16 to $18 per student year over six years. Further cost savings can be achieved through centralized purchasing, intra-school sharing of hardware, modification of certain laboratory activities, and outside supplemental funding (e.g., local, state and federal).

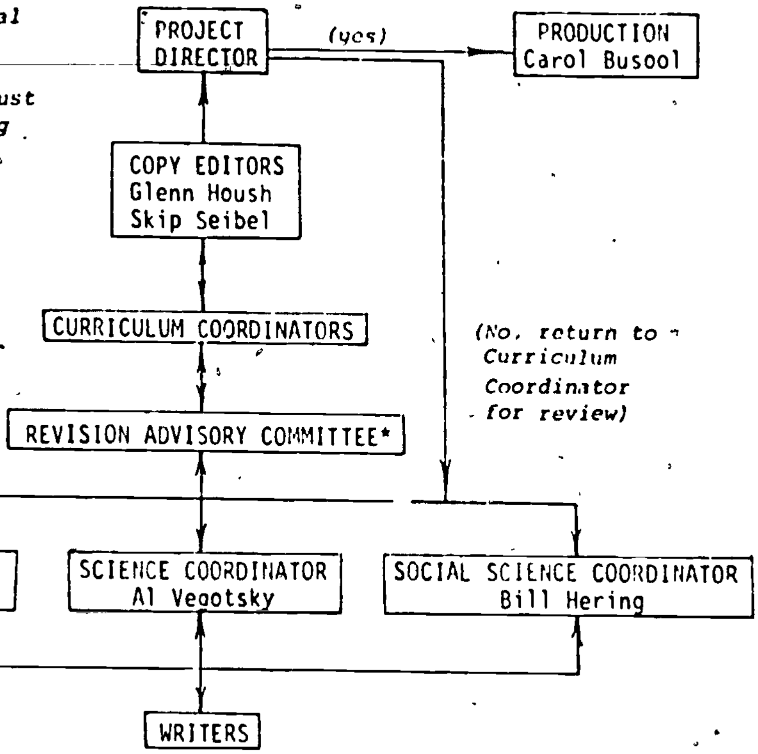
TABLE IX
BICP REVISION PROCESS

Individual opinions:

Yes--Pass, unconditional (unanimous)

Yes--Pass, conditional (person opposed must submit, in writing to the chairman, constructive criticism for conditional pass)

No---Person opposed must submit, in writing to the chairman, constructive criticism



*REVISION ADVISORY COMMITTEE (7 voting members)

1. Discipline Coordinators
   a. Math: Jon Hanshew
   b. Science: Al Vegotsky
   c. Social Science: Bill Hering
2. Two students as consultants (UCB, Merritt, etc.); three trial teachers (OHS) as consultants
3. Copy Editors
   a. Glenn Housh
   b. Skip Seibel
4. Project Director (Alternate Chairman, non-voting)
5. Project Coordinator, Ron Linder (Chairman, non-voting)
6. Production, Carol Busool (consultative, non-voting)

*The Revision Advisory Group will establish curriculum goals, meeting dates, etc., and deadlines for revision.

FIGURE X: THE COST OF A BIOMEDICAL COURSE

ITEM	UNIT COST	QUANTITY	1st Year	2nd Year	TOTAL MAINTENANCE COST/YEAR for 3rd Year
BIP	$80	7-10	$560-800	$350-500	0[a]
Computer Components	50	7-10	0	$350-500	0[a]
Laboratory Supplies			400-500	250	$250
Textbooks			990	990	0[b]
Worksheets			0	0	50
	TOTALS		$1950-2290	$1540-1740[c]	$300

[a]No maintenance costs with unlimited use.

[b]Textbooks can be used for six years.

[c]The cost of implementing and maintaining the Biomedical Course for thirty students over six years ranges from $773 to $858 per year, presenting a cost of $26 to $28 per student year.

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D. 18. c:BICP (Panel 4): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The proposal for funding indicates that the Biomedical Interdisciplinary Curriculum Project was developed partly in response to the needs of society for expanded health manpower. In addition, the faculty of schools involved in the original Richmond (California) project felt that an interdisciplinary curriculum to prepare students for careers in the health care field would appeal to those of average or higher ability whose achievement had been below expectations.

The proposal also refers to the report of the Carnegie Commission, Higher Education and the Nation's Health in 1970, statements of the Assistant Secretary of Health and other predictions about patterns of need in health manpower. Subsequent reports of the Health Manpower Bureau of HES and predictions based on surveys by hospital associations, Regional Medical Programs and Comprehensive Health Planning Councils seem to corroborate the validity of these predictions.

In the early 1970's, Commissioner Marland reported a survey that showed 30% of the vacancies in health care being filled by persons with no pre-employment preparation. Most health careers require post-secondary education so that an interdisciplinary health-related curriculum that provides the maximum number of options in a career cluster fills a special need.

Students who are attracted to health careers need an opportunity to learn about the variety of available careers, the educational requirements, and, most important, an opportunity to perceive the interrelationships of physical and social sciences with actual applications in health care.

Limited data suggest that 10-15% of the high-school population will elect a health-related career. The original project objectives describe the target population as those students who have an average grade of "C" or better, have successfully completed first-year algebra, and read at grade level. Discussion with the project director indicates the project serves all students preparing for health related careers. The panel questions the advisability of attempting to serve too diverse a population.

Based on an examination of the course materials and the report that 85% of the pilot students from the first two years of the project have enrolled in college, the panel believes that the materials are directed toward the top one-fourth to one-third of high-school students. The panel feels that this project does not meet the need for the identification, motivation and secondary school preparation of students with career goals that require a limited post-secondary education of a less technical nature.

Quality high-school course materials with an interdisciplinary approach to health careers are not available. The NSF support of curriculum in this area serves this need. The panel considers the extensive time commitment of BICP (4 hours a day for 2 consecutive years including mathematics, social studies and science) to limit the student's options of elective programs more than is desirable. Panel members thought that the objective of the program might still be achieved with a reduction in the time required by at least 25 .

Question 2: Is there a market for these instructional materials?

The BICP materials are intended to replace two years of science, mathematics and social studies at the 11th and 12th grade levels. It is not necessary or desirable for an entire school curriculum to be committed to this extensive block of time. BICP does provide an alternative plan or option for students interested in health-related fields. Most state and/or local school graduation requirements call for one or two years of social studies specifying that the student include a year of American History and sometimes a semester or two of American Government. This requirement would not be satisfied by the BICP course as it now exists.

Dissemination of project materials and philosophy appears to be relatively sporadic and lacking in systematic plans. Utilization of the materials in the Detroit school system was a result of individual interest and concern. Based on information supplied by the project director, it appears that many of the schools selected for trial in the Detroit area represent a different student population than was used in the California schools. If successful, this may illustrate the adaptability of the course to varied student groups and environments.

It should be stated that plans for dissemination and implementation are currently being formulated by project personnel and that a program of in-school orientations is being presented with NSF funding during the 1975-76 school year. It is felt that if the project is to have full impact, dissemination and implementation monies will be necessary from national funding agencies.

The free market has done little to respond in a systematic way to the needs addressed by the BICP program. This is understandable because of the relatively high cost of developing the materials and the uncertainty of the market for such a product. These factors do not minimize the need to provide such a program as a learning alternative to students.

The Project Director reported that eight publishers are currently expressing interest in BICP.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The goals and purposes of BICP are embodied in the proposition that the delivery of health care will continue to play a large role in our economic life and that an early career introduction in grades 11 and 12 toward health-related careers would be desirable for students interested in pursuing them.

The panel regards BICP as a frankly experimental effort which should be watched by educators and the general public concerned about alternative modes of education for the citizen in the latter part of the twentieth century.

Given the need for a curriculum of the BICP type, the panel finds the selection of the course materials reasonable and appropriate. It is hard to imagine that no other alternative assumptions, values and goals could

generate materials to meet this need. BICP provides an interesting new experimental model.

The materials appear to be well presented by a team of competent writers. The laboratory manuals, in their latest form, are interesting and understandable.

The sequence of presentation, particularly in the science component of the course, departs radically from tradition and this will be discussed further in question 4. It is difficult to predict the effects and likelihood of success of BICP in our high schools, but the panel is encouraged by the optimistic reports from the pilot schools.

Question 4: Is the content of these instructional materials scientifically correct?

The panel's impression of BICP is that the material is produced by persons of high scientific competence and that there are few errors of substance. The material is current and should be kept current. Medical technology is subject to rapid changes, and it is essential that the illustrations and examples in the course be reviewed and revised frequently to guard against obsolescence.

The BICP science component is quite innovative in the organization of the instructional material in that it is structured according to biomedical systems. This ~~approach assumes that~~ different topics from a particular scientific discipline, such as chemistry or physics, are distributed among the eight units. On the other hand, the Biomedical Mathematics course has retained a more economical and traditional sequence of material. The social science component strikes a balance between these two approaches, but does not seem to be enforcing an artificial pattern of organization.

The panel is concerned with the degree to which BICP succeeds in its effort to integrate the various component disciplines into a coherent whole. There is much to be gained from breaking through the barrier between traditional disciplines and unifying the teaching of them. However, some questioned whether the various systems of the human body provide a sound framework for high school science. Time and experience, rather than excessive speculation, will provide the answers to this question.

The science component of the BICP is designed to provide an experience for those who have a career interest in health related fields. It is not technical training.

It would seem from sampling the materials that the sci ce covered in this course may be of value to any citizen regardless of h or her vocational aspirations. Those with an interest in human biology and those with a vocational identification with the course would be especially interested and motivated to learn the material.

The program should be very effective in developing citizens literate in important components of science but BICP will not cover all science principles commonly included in traditional science courses.

The objective of the program is to provide as many options as possible to students. The project director reports that approximately 90% of BICP students entering college chose a health-related curriculum.

The coverage of the BICP material is quite broad in its total scope. Tables are given which indicate the unit titles for the biomedical mathematics, sciences and social sciences. The specific details as to the topics covered in physics, chemistry, clinical science and computer science are not presented. A hierarchy or a set of learning objectives for the total material is not explicitly presented.

It appears that the material in physics and chemistry is not covered in the same depth as in a standard high school science course. The material on biology is less comprehensive than a standard biology course but has more depth in selected areas. The Biomedical Instrumentation Package (BIP) is excellent and serves an integral part of the curriculum. It presents an excellent hands-on approach to practical laboratory measurements. The question of how the project material will be integrated with post-secondary biomedical curricula deserves further study.

Comparison of scientific content in BICP with that in traditional courses is made merely as a point of reference and does not imply a deficiency in and of itself. The intent of this program, as had been mentioned before, is quite different from traditional programs.

Question 5: Is the content of these instructional materials educationally sound?

The panel feels the content of these materials is educationally sound and especially relevant to the health career emphasis. Both the materials and the activities relate to the stated objectives. However, there may be some possible adverse reactions to these materials if the students to be served are not properly identified. For example, the mathematics background and applications are quite extensive and possibly beyond the ability level of average and below average students.

The study of the anatomy and physiology of the reproductive system and the biology of sex is important and well-presented. The panel suggests that parental approval be obtained in writing prior to instruction, as has been previously done.

One of the experiments dealing with the effects of alcohol describes a problem where a student gives beer to his pet hamster who eventually dies as a result of too much alcohol. This is an unfortunate example that some members felt might encourage students to try this with a similar animal.

The BICP materials are noteworthy in applying the processes commonly practiced in sociological research to the issues being studied. The panel feels that the integration of physiology, chemistry and physics with health field application will have a beneficial effect on the students. Traditionally these aspects have been compartmentalized in different courses and students make their own integration efforts.

This curriculum appears to be particularly appropriate for the above average student who has a pre-determined desire to pursue a career in health related fields. The materials and approach should not be used for the below average student or one with a weak mathematics background. Students without a strong self-commitment and desire in health related careers would likely experience disappointment.

The social science component appears to be the only area with much emphasis on value-laden material. There are specific exercises dealing with such topics as values clarification but they appear to be fairly presented and deal with broad social issues. Realistic attempts have been made not to exclude minority populations and their related values. For example, the format in Unit II allows students to study a transition of five village cultures and continues in Unit III to study the United States from the question sets students used to analyze these cultures. The group discussions which follow (where each group attempts to refute the answers written by the other group) prevent the curriculum from being centered around pre-determined issues or value systems.

> Note: Unit IV, which reportedly contains a section on value clarification, was not available for review, but it is assumed that it presents the value issues with the same open-ended approach.

Question 6: Are the proposed and anticipated outcomes of these instructional materials desirable?

The anticipated impact of these instructional materials may be far reaching in channeling a directed course of study in health science for 11th and 12th grade students. BICP allows average and above average students with interest in health related careers to explore, within an interdisciplinary framework, various skills, principles and tasks related to those careers. It follows that these instructional materials are desirable for this selected group of students.

It is anticipated that teachers involved in this program will develop competencies in presenting interdisciplinary topics and applied skills.

The process of designing a science curriculum around a two-year multidiscipline program seems unique. The materials are well written and organized to present a comprehensive view. There is some concern among panel members that this emphasis might limit student interest in the broader science curriculum. The extensive list of health related career opportunities presented in the social science component is impressive.

Question 7: Do these instructional materials present implementation problems for the schools?

The project director informed the panel that guidelines for implementation are now being prepared.

The scope of the material covered in the science units of BICP is such that many traditionally prepared science teachers may feel a need for additional

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study. It seems possible that the broad background needed to teach integrated biology, chemistry and physics might discourage some teachers from attempting the program. Some districts might not have the properly qualified personnel to implement the program.

As in any effective implementation of new curriculum materials, a definite in-service program needs to be established with proper funding to include the following areas:

1. Criteria for student placement in the program.

2. Expected outcomes of the program.

3. The importance of team teaching techniques to an interdisciplinary program of this type and strategies for effective team teaching.

4. Familiarization with instructor's role and supportive materials provided.

The project director has indicated that the program's success is directly related to the extent of coordination among teachers. It seems imperative that great care be taken in the choice of these teachers. The science teachers also need a strong laboratory orientation. Schedules should be arranged so that team teachers have at least one daily planning period together.

Several organizational problems may arise from the use of BICP. The most serious seems to be the number of hours of the school day which are consumed by the program. If a district schedule has six instructional periods per day, with BICP involving four, only 2 periods remain for other required courses. In some states courses such as U.S. History, American Government, P.E. and English are required. This would prevent a student from choosing electives of an enrichment nature. Highly motivated students could complete their other requirements in summer sessions where feasible.

The concept of an exploratory course in health occupations is very appealing and a desirable option at the 11th and 12th grade level. It is the feeling of some members of the panel, however, that despite the excellent quality of the materials, there are a number of apparent contradictions among the stated objectives, the content and the pilot students. The proposal summary states as an objective "...to prepare and motivate students for entry into any one of a variety of programs beyond high school that would eventually lead to careers in the health-care field."

Based upon the experience of some panel members, some students of marginal science or math ability have indeed become successful in health-related fields and might have become discouraged had they done poorly in this program.

The pilot students have been A- to C students and therefore have had a high success rate. Students in the 1975-76 pilot schools in Detroit are apparently proceeding at a much slower rate although hard data are not yet available.

Several recommendations made by panel members are:

1. The first year might begin with less rigid material, working into areas of greater difficulty at points where less academically inclined students might reasonably switch to other programs. This would provide all the interested students the opportunity to explore career choices without becoming discouraged.

2. The program may restrict the average student too greatly. A suggestion was made that the time involved in the program be cut 25% (i.e., from 4 periods to 3). Admittedly, this might cause many problems for the authors, possibly compromising the intent of the material.

3. The program, as well written as it is, might be extremely useful in minicourses or modules. In modular form it could be inserted into existing curricula at both high school and community college levels.

4. Some panelists felt that the convertibility of this program with regular college prep programs was not as great as desired and could cause problems for any student who changed his mind about a health career.

Since this program is an optional class in itself, the students will obviously be a special interest group. Provisions must be made at the local level for students choosing to drop out of this program.

The practicum component of this program between the 11th and 12th grade necessitates availability of nearby medical facilities. This is not a requirement of the program but would be very instructive to interested students.

No other facilities other than ordinary laboratory space and equipment are necessary. There may be a problem with this laboratory requirement if space for other science courses is already limited.

The BICP package is an impressive attempt to serve students with strong motivation to enter health related careers which require a strong science component.

Question 8: Are the costs for implementing these instructional materials reasonable?

The stated costs of $26 to $28 per student year, while perhaps justifiable, are somewhat excessive. However, it should be recognized that three traditional courses are to be replaced by this course in the 11th and 12th grade years. Also, schools that are interested in experimenting with new approaches to secondary education are usually prepared to assume initial costs that are higher than those experienced in an established program. The ongoing costs estimated beyond the sixth year of implementation are

reasonable, averaging only about $10 per student per year, or an average of $3.33 per student per course per year since in some schools it is intended that three traditional courses will be replaced by this course.

It is important to note that publication costs are rising rapidly. It is conceivable that the estimates made above could be low by a factor of 50 to 100%.

Because of the vocational nature of the BICP, it may possibly qualify for federal support under the Vocational Education Act. In this case its attractiveness to a school district will be enhanced. This would have an important impact on adoption and implementation throughout the country.

Question 9: <u>Is the management/organization plan adequate for producing these instructional materials?</u>

The project director reported specific examples of the project providing opportunity for scientists, teachers, students, and parents to make input into the program. As an example; the director reported that copies of the unit on <u>Human Reproduction</u> were sent to parents prior to students studying the unit and reactions from parents were requested. The evidence reviewed by the committee contained information related to the establishment of the Revision Advisory Committee and a flow chart outlining the revision process. Communications and lines of administrative authority appear clear. Teacher teams prepared position papers based on their experience teaching BICP. Students who had completed the program responded to detailed questionnaires. The evidence reviewed by the panel reports generally favorable attitudes toward the program along with suggestions for revision. The director reported that the evaluation data obtained is being utilized in the revision process.

The opportunity for input and the internal monitoring of the project is viewed as adequate by the review panel. The project director reported that no external, independent evaluation was conducted. The panel is of the opinion that external independent evaluation is desirable. It follows that NSF should be provided funding for this purpose.

The project appears to be appropriately administered with adequate personnel assigned to leadership management roles.

D. 18. d:BICP (Panel 4): Individual Panelists' Responses to 10th Review

Question: What are your general impressions of the curriculum?

Panelist: Dr. Jacob Blankenship

The BICP curricular materials appear to be scientifically accurate and educationally sound. The uniqueness of the program is viewed positively with regard to the interdisciplinary nature of the program and the perception of this reviewer that the program is an "academic program with a career orientation." The length of per day time (4 hours) devoted to the program seems excessive when one considers the restriction this will place on students with regard to selecting humanities type electives as well as courses that will satisfy graduation requirements.

The quality of the materials reflects thoroughness and effort on the part of the project staff. The use of an interdisciplinary approach to the study of science strengthens the program and increases its attractiveness as another learning option available to students whose school districts are willing to adopt the program.

This program is an example of a curriculum alternative not likely to be developed without federal funding assistance. The market potential prior to the development of such a program is too uncertain to expect publishers, for example, to invest in the research and development activities necessary to produce such quality materials.

Panelist: Dr. John Corriello

The BICP is an innovative curriculum that attempts to demonstrate how knowledge from traditional scientific disciplines (biology, chemistry, physics, mathematics) are used in health related areas. It is more like the curriculum that one would find in a professional technical school rather than the more traditional U.S. high school preparing students for entrance into a liberal arts educational institution.

This curriculum is pragmatic and applied, and would tend to increase interest and motivation in students particularly prone toward a career in health areas. It should be closely monitored to see its effects upon students who have experienced it. What happens to them? Do they enter and practice in any health related discipline or what?

Panelist: Dr. L. Scott Chalfant

These curriculum materials appear to be particularly relevant to those students who are average to above average and have a definite interest in pursuing a career in the health related fields.

The interdisciplinary approach has merit and certainly is to be encouraged. However, my personal experience has been that it is the exception rather than the rule to find three or more teachers that are compatible and effective in a team-teaching approach. Therefore, I feel this would be an important consideration and limiting factor for many individual schools.

The materials are well-developed, sequential and fit well into the interdisciplinary approach based on a problem-solving technique. The biggest single draw-back that I see in the organizational structure of this program is the fact that it requires a student to commit four hours each day to the program, thereby greatly eliminating his potential to select other elective courses (art, music, industrial arts, business, etc.) to provide him/her a well-rounded curriculum. As a result, I would strongly recommend that consideration be given to combining the math in the two hour science block so the "core course" time commitment is reduced to three hours. Another possibility would be to develop these materials in "modular packages" rather than sequential as now designed.

I was very impressed with the quality of the material presented and particularly like the problem-solving approach using current issues. However, since these courses replace existing curriculum, I feel there could be a problem with the Social Science component in many districts that require a specific base of minimum concepts in local, state and national government that is not provided for in this curriculum package. This would mean that students in these districts must take an additional course in Government to meet the local minimum requirements for graduation.

In summary, it is a well-developed and relevant curriculum which should provide the student interested in health careers with a highly motivating option to a standard course of study. Its success seems dependent upon two critical factors: (1) the <u>selection</u> of the staff for the interdisciplinary teaching approach; and (2) proper <u>in-service</u> once they are selected.

Panelist: Dr. Donald S. Dean

Some excellent material has been developed for this project. The parts in my area of competence seem very interesting and challenging. Students' natural interest in a vocational area and the intrinsically interesting matter should lead them to learn a great deal of science and relevant social science and mathematics. I would see this as a way to make good science relevant and attractive to students. I am not at all distressed that the coverage of science in this course is not identical with the coverage of traditional courses.

I am well aware of two problems: (1) the matching of the material to the students to be reached, (2) the problems of fitting such a large body of matter into a curriculum.

To elaborate on the first point, the program is too difficult for some students who should be in the health field. It is designed for better than average students while there is place in health-delivery field for some of less ability. At the same time, those who aspire--however unrealistically in some cases--to careers as physicians would probably choose a strict college-preparatory course in preference to this.

On the second point, a program that demands four hours per day for two years will surely be hard to integrate into the curriculum. There is a danger that it will exclude required social science courses and the

broad liberal-arts education desirable for all students and particularly for those in health-related occupations.

I should think some schools might find it desirable to use the science component apart from the mathematics and social science components. Perhaps there are other ways to make these excellent materials available in modules or otherwise without locking the students into such a large program. Finally, the course should not be criticized on the basis that it does not specifically prepare nurses' aides and hospital administrators alike; it is not intended that it should. The course is not intended as specific technical education. Most of the students will be taking further work after they complete high school and this is the place for specific training of those who do. I should think that the course would provide education of value to the general citizen as well as the student who does indeed continue on into health careers.

Panelist: Mrs. Ruth Ganong

My overall evaluation of BICP is one of enthusiasm, but I have several reservations. I like the innovative concept of coordinating a curriculum around a central theme that is both relevant to a student's present situation and to a possible career in the future. The course content seems well organized educationally, scientifically correct and well presented.

However, I would like to see this program further developed on modular lines so that students with varying degrees of skills could enter or drop out without being penalized.

Funding for an outside evaluation should be provided as the project manager has requested. Implementation money will be necessary for in-service training to insure that teachers grasp the interdisciplinary nature of the program.

I have been aware of the fantastic opportunity the earlier program offered talented ghetto youths in Richmond, California but I have a nagging concern that concentration on medical disciplines at the high school level will tend to cut off some general cultural advantages that students in a traditional high school might receive. However, in balance, I think this is a desirable program and will be beneficial to a small, but significant segment of today's youth.

Panelist: Ms. Sarah Hurst

Both the concept and the quality of the BICP materials seem good to me. Over the past several years as health occupations programs have proliferated in the comprehensive high schools, the need for such instructional materials has become increasingly evident to those of us working with pre-employment health occupations education. There are many nursing related programs in high schools, but little information about or preparation for the careers that require post-secondary education of a technical or scientific nature.

My impressions of the values expressed and the content are necessarily based on a skimpy sampling of the instructional materials because of the

time constraints on the panel. The scientific content seems based on the best information available and is consonant with currently accepted theory. Perhaps more emphasis could be placed on the fact that in health care we must hold all information somewhat tentatively because ongoing research frequently replaces longstanding procedures and explanations in medical fields.

Associated with exploratory (Career Education type) courses and a vocational, skills-oriented health occupations program offered in the same school, the BICP would offer students an ideal opportunity to investigate a career cluster and make realistic choices about the kinds of patient relationship and level of aspiration in the health care system. Success of such a program would depend on sufficient coordination to permit a student to move from one to the other as seemed appropriate.

Being in the vocational education department stigmatizes students who enroll. Many parents find such a program unacceptable regardless of the interest expressed by their children. Generally no academically acceptable parallel course offering exists. The BICP materials comprise an interdisciplinary, cohesive health related curriculum that can be used as a self-selection process to help the student gauge his motivation and ability to determine if they are congruent with his career aspirations. The BICP would permit the student to identify with the academic side of the house while he benefits from voactional experiences.

Additional benefits would accrue from putting the BICP materials into a more flexible format.

Having the BICP materials modular would make the possible combir tions of BICP plus vocational instruction approach infinity. Thus the student whose tentative career choice does not require the rigorous mathematics part could benefit from the other portions of BICP and supplement with the more skill oriented vocational units, etc. Transfers in the other direction should also be expected.

The clinical practicum is essential in my opinion. Without at least clinical exposure (observation), career choice cannot be based on reality so it is important for the student to experience the grim and grubby aspect of health care as well as the glamour and excitement. Post-secondary programs usually narrow the students' career options quickly so the clinical exposure should start early.

As for the BICP Project, a rigorous evaluation system--outside and inside--should be established before history and other threats to validity intervene between the California and Detroit pilot studies. If the project is funded further by NSF either for dissemination efforts or modification of format, etc., changes should be based on evaluation results.

I would recommend that an advisory board to the project be appointed and convened on a regular basis. Interaction among the members of such a group might well be synergistic and the project benefits greater than the present "curbstone consultation" described by Dr. Hughes, the director.

I concur with several other members of Panel 4 that science education might derive even more benefit from NSF funding if policies and guidelines were promulgated to assure that in guidelines for proposals the following elements are visible:

1. Needs assessment--a systematic, broadly based effort to assay the need for the proposed effort, including consideration of compatibility with other constraints such as accreditation agency policies, generally-legislated graduation requirements as well as the perceived needs of a target group of students.

2. Evaluation--formative and summative evaluation as part of the development plans and sufficient budget allocated.

3. Dissemination--models for dissemination to be part of project design with budget allocated for pilot testing of model.

4. Quality control of teachers' in-service preparation for classroom management of the new curricula.

5. Accountability--monitoring by NSF and/or an advisory group to assure no significant departure from proposal; i.e., changes in target population, philosophy or process without renegotiation.

Panelist: Dr. Eugen Merzbacher

As in any such large-scale project, there is always a danger that the new curriculum may be burdened with claims and expectations that go well beyond the limitations of the intended scope of the curriculum. Thus BICP should not be thought of as a cure-all for the manpower shortages in the allied health field, nor will this curriculum serve the very real needs of young people who rank low academically but could become well qualified technicians in the area of health delivery. BICP is academically demanding and depends, for its successful application, on the availability of talented science and social science teachers, who can adjust to the demands of the curriculum's multidisciplinary structure. Under favorable conditions, the BICP curriculum could attract substantial numbers of students who--while capable of academic work above the average--find the liberal arts track not to their taste and the traditional basic science courses not sufficiently relevant to their inclinations.

The standards which BICP has set for itself are high. The organization of the science material should be regarded as an experiment which, if it is successful, is likely to inspire similar but improved versions of a technologically structured curriculum.

Panelist: Dr. Robert Peura

I feel that BICP is an innovative optional track for a limited segment of high school students. The program would be more flexible and applicable to more students if a modular approach was utilized. It would appear that a modular approach would encourage more school systems to try parts of the program.

An independent evaluation of the program should be implemented. In addition, a study as to how the BICP interfaces with post-secondary medical and health service training programs should be considered.

Panelist: Mr. Harold Pratt

The NSF has very appropriately funded a project designed to meet a well identified national need that the publishing industry has not satisfied. The project has produced interesting, well developed sets of materials that are unique in their identified target audience and overall organization. Although there appears to be only a limited market for these materials, the need is significant and is an example of where federal support is imperative.

I think the project should have broadened its pilot population early in the development process. If the developers had consulted with a wide group of teachers and school systems the specialized and restricting elements of the program (team teaching, 4-hour block, two-year sequences, etc.) might have been modified or designed in a more flexible manner.

Panelist: Dr. Les Trowbridge

A strong feature of the BICP program is the recognition and identification of a special segment of the student population interested in health related careers, and the production of teaching materials for this group. Substantiation of the overall need for persons prepared in these fields was adequate in the proposal.

It is difficult to assess the potential ability of this project to meet the needs identified and referred to above. If the target population is average to above-average students whose interests lie in health fields, the materials seem to be adequate and perhaps superior to anything else currently available. If the target group is students who have interest in health-related fields of a technical or para-medical nature, but whose skills in reading, mathematics, abstract thinking, and other higher level cognitive abilities are minimal, the course will present serious problems.

Secondary education should be considered as general rather than specialized for the large majority of students. However, for the minority of students whose career goals may be firm by the junior year of high school, this course provides an excellent optional alternative to traditional courses at the 11th and 12th grade level.

A questionable matter concerns organization and time allocation of the course in the typical school day. It is planned that a minimum of four hours per day be provided for this course. Students choosing this option obligate themselves to a major block of time in the final two years of high school. Meeting other requirements for graduation such as English, American History, Government, Physical Education demanded by some high schools may produce serious difficulties for these students.

Considering the role this course in BICP may play in secondary education for a special group on an optional basis, this reviewer looks upon the project as a laudable effort deserving of continued support. Strengthening of the internal and external evaluative plans is imperative to give clear evidence of the specific advantages over traditional courses in mathematics, social science, and science for the specialized groups identified in the target population.

Panelist: Mr. Andrew Turner

My general impression is quite favorable. I found the instructions to be laid out in a simple and easily understood manner.

The content for the most part was fine. One incident in the math section of the BICP curriculum might offend some people, however. It deals with the death of someone's pet hamster through experimentation with alcohol. I think the staff should look out for things like this which can turn some students off. If an animal must die it should be one that is viewed as a lab animal or a pest rather than a pet.

The range of possible uses of the curriculum (especially the Biomedical Instrumentation Package) impressed me the most, especially after talking to Dr. Leonard Hughes, the Project Director. He told me that in some recent developments in the curriculum they have both open-ended and independent projects for students (such as a bread-board hook-up that simulates an artificial kidney).

I would recommend that accessories to the Biomedical Instrument Package (BIP) be made available to those schools that have students that wish to go on beyond the work in the course. This might include an oscilloscope or an oscillograph set-up (to work with the EKG equipment) or additional electronic components (e.g., transducers) to do electronics experiments. Thus the use of the BIP would be broadened significantly and the project would be made more successful.

Panelist: Ms. Judith Yero

Commenting on BICP poses a real dilemma for me. On the one hand, I see a set of excellent materials with unique, innovative approaches to the content. The slightly uneven quality in the depth of certain areas can be accounted for by the very nature of interdisciplinary materials.

On the other hand, I see a target population that is or should be extremely limited. The four-hour, two-year commitment at such an early age should be permitted only for highly motivated, above-average students who know they will enter the health field. Even for these students, the thought of limiting the elective choices and thus depriving them of the opportunities to take humanities or other enrichment courses distresses me. I keep envisioning a highly trained, poorly educated individual.

Having worked with students in the group defined as target, I am sure that the math would have been too rigid for many and would have discouraged students who have gone on to successful careers in health-related fields.

I do not believe most school districts could afford such an option for this limited number of students.

Again, let me state that the materials are so well developed that they should be available to many students who may be considering health careers. I would suggest that this could be accomplished by rewriting the material in module or minicourse form that could then be used as supplementary material in the existing curricula of high schools and even junior colleges. I would hope that NSF would fund this type of continuation for the program, as well as the development of internal and external evaluation methods and implementation to the extent of dissemination of information, in-service, workshops and institutes.

D. 18. e: BICP (Panel 5): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

The specifics required for determining a "genuine need" for these instructional materials were:

(1) not apparent in the project as proposed

(2) not supplied by the current project director (the director was interviewed by the panel) and

(3) never rationally agreed upon by this review panel.

In spite of this obvious deficiency there was a general consensus by members of the panel in recognizing the educational value of the materials produced.

This apparent dichotomy of "genuine need" for the development of these materials versus educational value is evidently inherent in the program itself since it is doubtful that the purported project objectives will reach the intended goal.

The panel acknowledges the assessed health manpower needs but it cannot foresee how the implementation of this curriculum will alleviate the problem significantly. Although perhaps not intended, the program may have the advantage of "counseling out" health career oriented students at an early age.

As the program is presently conceived the use of its materials would be realized by relatively few students. However, with considerable modification of materials and a change in the rationale to one which is primarily interdisciplinary and more sociologically oriented, a much larger student group would likely be targetable, as well as benefitted.

In summary, we consider addressing the need to supply adequate numbers of health professionals and paraprofessionals admirable. We are impressed with the inclusion of applied biological content into the curriculum and its attempt to secure interdisciplinary teaching. However, we do not feel the latter will result in solving the dilemma of the former.

Question 2: Is there a market for these instructional materials?

We know of no other curricular materials which meet the needs as postulated in the original proposal. However, existing health career instructional materials presently residing in vocational, technical and/or post-secondary areas of the educational system may meet these postulated needs.

The largest market for the materials already produced by the project is quite likely other than the secondary schools. Regardless of where the

existing market might be, a modularized version of the same materials would greatly enhance their marketability.

These materials could be placed into the existing curriculum by replacing science, mathematics and social science sections with the BICP courses. It is expected, however, that the implementation of the program would be very limited if implementation funds including those for teacher training are not made available. Other constraints on implementation would be expected, such as scheduling conflicts and the need to identify teams of compatible teachers.

There has been a great deal of rhetoric concerning adequate supplies of health manpower and the maldistribution of the present manpower. The usual approach has been directed at creating increased enrollments in professional schools, thereby accommodating a larger number of applicants. However, the project director in an interview indicated that this curriculum would whet the appetite of non-degree pursuing students who may not have been interested in the health fields. This may be the most sophisticated attempt (though not the only one) to motivate this targeted group.

Certainly large metropolitan school systems and intermediate size consolidated schools of 1500 students plus could have the number of interested students available to make the curriculum workable. Comments from the project director indicate enthusiastic acceptance, and this is understandable on the basis of the materials used.

In summary, no doubt a market for such materials exists though this may not be the market originally targeted. Regardless, these materials represent an alternative to current approaches in teaching applied biological principles. These materials may provide a more marketable area as mini-term courses in the secondary, vocational and technical schools as well as post secondary elective areas of study.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The overall purpose was to develop a curriculum which is motivationally, interdisciplinarily and instructionally sound and which enables students to develop either horizontally or vertically in pursuit of health careers. In addition, the program proposes to identify educational settings and produce student and teacher materials to which the curriculum could be applied.

The purposes have changed only slightly over the course of this project. The stated goals, however, seem to be inconsistent with the rationale for funding.

Some inferred assumptions, values, and goals include:

1. To inspire a student who will be more readily motivated to health science careers, and

2. To inform citizens who recognize and understand the conflicts as well as the positive interaction of science and society.

It is not reasonable to expect that this curriculum will fulfill the need as presented. The panel feels that this curriculum would be more acceptable and would provide more transportability if it could be developed into a modular form.

In summary, the panel does not feel that the assumptions, values, and goals in the proposal match the instructional materials. Although these instructional materials possess a clear purpose and rationale, we do not feel this clarity can be applied to the overall project design.

Question 4: Is the content of these instructional materials scientifically correct?

Perhaps the strongest principles of the BICP curriculum are the accuracy and currentness of its scientific materials. The single most persistent objection we have in this regard deals with the lumping of mental health problems with others of a more basic social nature. Current research indicates that many emotional problems are of a biochemical nature and hence organic in causation.

Whereas the instructional material is current at this time, there should be built into the program the opportunity for periodic introduction of new and updated knowledge. This would provide a more stimulating approach for the planned principal beneficiaries of the program who may not be future health scientists necessarily. The panel felt that we should point out to the program director that this curriculum may prove more applicable to students who do not pursue the health sciences by providing their best opportunity to learn applied principles of biological science.

According to the project's proposals, an effort at interdisciplinary teaching was to result from the design. As it appears this has developed into a multidisciplinary approach as opposed to an interdisciplinary one. In particular we are concerned with the lack of application of social science phenomena to the natural science area but were acutely aware of the tremendous amount of natural science introduced in the social science unit.

In summary, we find that the materials are basically correct but fall short of the rationale in the original proposal.

Question 5: Is the content of these instructional materials educationally sound?

The soundness of the instructional material, its applicability to familiar situations and its extensiveness are excellent. All information provided is relevant although we are disappointed that the science and mathematics presentations lacked any innovative methodology. We may expect some adverse reaction from students who may be persuaded to enter this curriculum. We feel it is more rigorous and demanding than its directors surmised. We doubt that many average students could meet its intellectual demands. It does appear to be geared to students of a particular bias in health career orientation, and to students of a higher intellectual capability than suggested by the BICP project staff.

Whereas the teacher's manual has creditable procedures for approaching value-laden topics, some of the topics which are inherently controversial may require specialized input and handling.

In summary, it is our general feeling that the program was educationally sound, but noteworthy for its lack of innovative style and methods. We seriously question the suitability of the materials for the groups targeted and suggest there may be an unintended, but very real, "selecting out" process resulting from the implementation of this curriculum.

Question 6: Are the proposed and anticipated outcomes of the instructional materials desirable?

The proposed and anticipated outcomes of the instructional materials may be desirable, but that does not assure their being compatible. Perhaps the most important anticipated outcome involves allowing students who are considering health careers the opportunity to obtain experiences related to these careers and make more accurate estimate of their suitability. Another outcome may be to stimulate teachers to participate in team teaching and interdisciplinary exchanges. Communities, through their school boards, could also become excited at the prospect of participating closely with the schools in the carrying out of the program. This may be another avenue for adult and continuing education.

The intended effect of the program according to the proposals is the stimulation of interest in the health careers area. However, in entering such a specialized curriculum, admission rests on this presumption. Furthermore, there are no data to support less, equal, or greater acceptability of these students to higher educational institutions as a result of the program.

There does not appear to be any social, sexual, ethnic or religious bias presented. This may help mold an atmosphere of free exchange of information and communication on the part of students and teachers alike.

In summary, having reviewed the original proposals and the most current information packages, we find the proposed outcome at odds with the antici-

pated outcome. However, to restate, both the proposed and anticipated outcome are desirable; we simply question the premise that the former will result from the implementation of the program.

Question 7: Do these instructional materials present implementation problems for the schools?

There will be some problems in implementation. In order to use the instructional material effectively, teachers will probably need training in team teaching techniques. They will need the opportunity to study areas outside their own disciplines. Importantly, techniques that will result in the teacher interchanges must evolve. It would appear that implementation may be especially difficult for the teacher of social science as this portion of the curriculum is the most truly interdisciplinary.

Many secondary schools are organized within the parameters of subject areas. The multidisciplinary setting of this course will require special scheduling of teachers and students for class time and for the "team meetings" inherent in a team approach.

The learning resources important to this curriculum include the proximity and availability of health facilities. There may be another positive aspect of this program through the involvement of community health core teams in the project. Certainly medical advisory groups would prove helpful to students and teachers alike.

Question 8: Are the costs for implementing these instructional materials reasonable?

The costs of the project seem reasonable provided the proposed outcome is achieved. We are not convinced that this will occur. According to the project staff, implementation costs per 30 students for the first year would range from \$1950 to \$2290 and \$1540 to \$1740 for the second year. Thereafter the cost will be \$300/yr. Perhaps these estimates are low with the inclusion of an oscilloscope, without which the BICP does not appear to accomplish its described potential. Suitable oscilloscopes range from \$400 up.

We question whether the maintenance cost of the BICP, as listed, is correct. Some units will be broken in transit and we doubt that any electronic instrument is free of periodic breakdown. The summer practicum costs seem to revolve around the availability of adequate teaching personnel required for its realization. Certainly, if the medical facility is available, implementation costs through medical supervision would be negligible. Cost could become a major factor in less affluent areas and areas removed from major medical facilities.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

The management/organization plan is adequate. External monitoring by the NSF was frequent. We are uncomfortable with internal monitoring. Several

questions of a serious nature have been raised that should have been obvious to the original drafters and certainly to project personnel as time progressed.

Projects of this magnitude require broader based review such as those presently being undertaken.

D. 18. f: BICP (Panel 5): Individual Panelists' Responses to 10th Review

Question: <u>What are your general impressions of the curriculum?</u>

Panelist: Dr. Daniel F. Burton

Most educational agencies, local or state, have begun to question professional personnel about cost and effectiveness of programs. Shrinking enrollments, the slowing of national economic growth, resistance to taxes combine to give Congress, legislatures, and school boards the choice of cutting personnel, buildings, teaching materials. or some combination of these. To make choices of programs to cut or new programs to initiate, appropriation committees and boards need to know which programs or projects can be proved to have a positive value for students. The most effective way to obtain data on a program's value is to determine how students' skill level ~~and/or~~ attitude and/or behavior have changed as a result of participation in a program. NSF terminates its role just prior to dissemination which inhibits collection of such data. I recommend NSF budget for follow-up of disseminated projects to document successes (and to discover causes of failures, if any).

Panelist: Mr. Wayne E. Carlson

From the viewpoint of the parent, I think that there are two very exciting benefits of this curriculum:

1. The multidisciplinary approach to education
2. A new exciting approach to learning personal and public health.

In applying the first, however, there may be some problems. Schools and teachers may be hesitant to adopt new teaching methods required or may be hesitant to share their "domain" with other teachers thus making implementation difficult. Schools may not be flexible in their building design or they may be too small to have the required variety and numbers of teachers.

I believe the greatest benefit may be in terms of the learning that takes place about personal health through awareness of their own bodies and how they function. In rural areas particularly, there are many people who do not avail themselves of health care due to economic reasons, inaccessibility, fear or superstition. These people, if they knew more about their bodily functions, may be able to overcome some of these barriers. Usually in these same rural areas, medical care may not be as readily available. A comprehensive health education of this type over time may assist a person in recognizing when personal health care is needed. Youth who are going through a difficult transitory period in their life would also benefit from greater knowledge of their own bodies and resulting capabilities or limits. Even if they never pursued a health career, it would benefit them all through life.

The only concern I would have would be in possibly raising false expectations in the youth who may desire a health career and then find the openings too limited in terms of entrance requirements.

I believe the materials are scientifically sound. They may be improved by considering a modular format for greater flexibility.

I would also advocate NSF funding for a study one year after initiation of a curriculum in a pilot situation to determine the effect on the student's health habits, knowledge, and aspirations.

Panelist: Sister Shirley Corbliss

The curriculum is not interdisciplinary. There is simply a connection among the disciplines involved. The instructional materials are extensive and relevant. They contain some very good applications of science principles. The social science portion deals very well with topics which are of great importance to social health in today's society.

If the materials were in modular form and not constrained by the two periods of science per day requirement, there would be a greater chance of a wide acceptance. As they stand, the materials do not seem directed at the goals stated in the proposal. They are geared to a selected group, not the average to above average student. They are not interdisciplinary, the meshing of the disciplines is dependent almost completely on the teaching team. Because of the selectivity of the group who will most likely take this course, the goal of developing a citizenship aware of the medical-health issues in today's society will be met in a very limited manner.

The social science component used as a social science course in a school, independent of the rest of the Biomedical curriculum, might better accomplish the stated objectives of developing an informed citizenry.

Panelist: Dr. Richard A. Dodge

My general impression of BICP is one of a specialized curriculum designed for a highly selective and narrow potential audience. I do not see much application or for that matter, need for this kind of program at the indicated target population. The program may even be charged with elitism. I do not believe funds expended have been used most effectively based on the product produced. Produced materials suffer from lack of continuity and benefit of pedagogical developments and trends which existed at the time of formulation. My impression (not substantiated) is that the project was designed for a special interest group with more interest in providing overhead and salaries than designing a meaningful curriculum. The project has been lodged with three different organizations with shifts in administrative personnel and little apparent continuity. Projects suffer from these kinds of major shifts.

I do not recommend further funds be expended for development or implementation before a serious review of goals, intents, materials developed and needs assessment is made.

The values of the curricula do not seem to be offensive, no new scientific trends or techniques are offered and little innovation re instructional techniques are in evidence.* I would recommend a full study of expenditures and outcomes be undertaken. I do not see a viable market for these materials nor in my experience am I convinced that a commercial publisher will find the materials a profitable venture. I hope this assessment is in error.

* In fact scientific content and pedagogical approach could be categorized as "ho-hum."

Panelist: Dr. Roger W. Hanson

Of all the programs reviewed by this panel the BICP singularly showed little, if any, acceptable rationale and/or approach to development.

This panelist feels that this particular program should never have been funded by any federal agency and particularly not by the NSF. The reasons for so stating include:

1. The intrusion of health professionals into the secondary educational system--an area which is not intended to be preparatory for specialities, health or otherwise;

2. A flagrant duplication of many materials, and some programs. which already provide for similar training in our vocational and technical educational systems;

3. The realization that a "Regional Medical Program" was a prime mover of the project; and

4. Although I agree with the peer review system it is very difficult to determine what might constitute the peer groups for this program.

In spite of this admittedly, drastic response, the materials possess considerable educational value--even for the secondary level. However, maximum value could only be realized provided such materials were in modular form.

Panelist: Dr. Fred D. Johnson

The materials developed in this project have merit. However, I did not feel that they would produce the desired outcomes as stated in the proposal. The "average" student would not be able to handle all of the material successfully. The materials impressed me as being multidisciplinary instead of interdisciplinary.

Some of the materials and exercises which involved sociological concepts were exciting and educationally appealing. However. I have deep reservations about very many school districts implementing this curriculum due

to the lack of a dissemination plan and teachers being adequately prepared to handle the program.

The time required to implement the program over a two year period also would make this project objectionable to many school districts. and the cost of implementation and maintenance of equipment would prevent some of the schools from using this program.

Panelist: Mr. Andrew H. Miller

The BICP program possesses the needed material for an interdisciplinary science program. The research and factual content are excellent in the math and science text. The social studies section examined by the panel lacked a needed mention of the biological causes of psychological disorders, attributing all mental disorders to environmental causes. This type of inaccuracy does not belong in a social studies text. Aside from this particular fault, no other serious ones were really discernible. The text materials are exciting in their ability to form an applicable relationship between the sciences and mathematics, yet the presentation itself is rather poor.

The materials lack the ability to hold the attention of the average student or the slightly below average student. The panel seemed to be in agreement over this statement. The initial goal of the BICP was to provide more students to more capably fill the "health care worker" need. The need for additional health care workers does exist but the answer is not at the secondary school level. The production of more students for the already highly competitive medical, dental, physical therapist, and nursing school positions would only complicate the production of new health care workers. At present the professional schools are too overcrowded and the students produced by the BICP training are not the students who will settle for paramedical skill training if they do not succeed in attaining acceptance to a professional school. The program is not geared to focus only on the above average student alone. However, the above average student is the only one capable of handling the intense studies properly. This high ability student will probably not settle for nurse aide or EMT positions. If the BICP program were set up along the guidelines of a modular system of electives rather than a curriculum type basis, it would probably be more effective in achieving its goal as an enrichment program.

The BICP program also needs a large school enrollment and, thus, becomes a program limited to the larger cities where health workers are not needed as readily as in the rural areas. The BICP's practical application in its present form is definitely limited.

There are other bio-medical courses that do exist and can be performed with less expense and greater effectiveness. The BICP does not seem to possess much of an educational future in its present form and with its present goals.

Panelist: Dr. Gerald A. Myers

The curriculum (BICP) is a well documented scientifically accurate and well integrated interdisciplinary package.

The need of such a program to motivate people into the health areas is questionable, more so than it was 5 years ago. The manpower needs in the allied health sciences may not be as crucial as they were when the package was conceived but it wouldn't require much modification to serve a non-health-oriented student as a 2-year program in social science-math-biology curriculum.

The program appears to be developed for a large school audience where it would serve as an optional program. It would therefore tend to omit many prospective students in rural communities where such optional programs are not practical.

The apparent lack of evidence of internal monitoring, planning, the apparent lack of informing the public and educational community of development progress, the lack of any specific plans for external monitoring and the apparent lack of carrying out this process are evident. Other shortcomings include:

(1) The limitation of distribution potential to relatively large school systems,

(2) the conventional organization of the curricular materials,

(3) the non-modularization disallowing implementation of segments into smaller school systems,

(4) the discrepancy between 10 April '75 proposal review sheet and the schedule of activities (included with corrections), and

(5) the use of lab equipment not encountered in actual lab situations.

Panelist: Dr. James M. Stevenson

The report in general from panel 5 on the BICP adequately delineates my feelings. I would like to add an additional comment and a suggestion.

It is difficult to understand how a project of this proportion could continue for so long a period of time without someone comparing the developing outcome with the original and continued objective. The program director, in an interview, did not alleviate this concern. These materials will not meet the objectives of the project.

However, the materials are excellent in their own right. The attempt to create an interdisciplinary approach falls short but is laudable in the attempt. The material is undoubtedly more interesting in presentation format than the more traditional science, math, and social science

courses. I see no reason why this alone is not justification for its being used as the basic curriculum in any high school setting, regardless of size.

Whereas I feel that the material, as written, is too sophisticated for most of the student population targeted, I would suggest that a simple rewrite and exclusion of upper level mathematics and physical science principles be considered. Why not add a simplified version of this curriculum to vocational training? Emergency medical technicians, nurses' aides, inhalation therapists, etc. are not often college material and don't require the command of such demanding information.

Finally, we need more college level professional training positions not more bright, interested students pursuing medicine, nursing, dentistry, and the other professional health areas. This curriculum may serve to produce more frustrated, hopeful pursuers of medical professions than we have already.

Panelist: Mr. J. Howard Straiton

The panel has been generous in acknowledging the material as sound, and I concur, "its applicability...and its extensiveness are excellent." The review by panel 5 does this with a circumspection that also merits re-emphasis:

The material relates to a "need" unrecognized by the public of most communities or the members of secondary comprehensive high school faculties.

Although socially significant, its acceptance on the market would be limited unless it is reconstructed in modular units. The program will not be perceived as an easily adaptable alternative in the contemporary programs now in existence.

I understand that rewriting so extensively as to put the materials into modular form at this point in time would be economically difficult.

Panelist: Dr. Robert E. Yager

The curriculum represents interesting activities, sequencing, and interrelationship for a certain type of student. The availability of such a program is desirable. However it is probably appropriate for relatively small numbers of secondary students.

Certainly the personal approach to the writing, the emphasis upon application, and the attempt at an interdisciplinary approach are all commendable features. Considering that the common science in the secondary school has been characterized by its "pureness," the BICP materials are a refreshing departure. It is unfortunate, however, that persons nearer the "cutting-edge" with respect to philosophy and organization of secondary science education were not more intimately involved.

The materials seem most appropriate for high ability students--perhaps those aspiring to study medicine at the college level. Little is done that seems stimulating or appropriate for persons interested in health careers directly

upon high school graduation or following an experience in a Community College. The "need" today is not for more pre-medical students.

There is an inconsistency in terms of stated goals and the resulting materials.

Panelist: Dr. Dean A. Zollman

The presently available products of this project are inadequate in many ways. I suspect that the difficulties stated in the panel report are a result of the process by which the materials have been developed. As far as I can tell, classroom teachers and professional educators had little input into the development stages. Thus, a set of courses evolved which completely miss the target audience.

Consider, for example, the treatment of Newton's Laws of Motion. The mathematical development of these principles requires a knowledge of calculus. Yet most university-enrolled pre-medical students are not required to use calculus in their physics courses. (This statement is documented by a survey performed by the American Association of Physics Teachers, October, 1975.) I admit that the calculus is presented in the BICP mathematics course. However, I cannot understand why students who are to be in allied health fields should need a much higher level of mathematical sophistication than required of future physicians.

Another point which I consider even more important is the level of abstract reasoning which seems to be necessary to succeed in both the mathematics and physics portions of the curriculum. At a time when research has indicated that students are developing abstract reasoning capabilities more slowly than we had previously thought, the project staff has produced course material requiring mostly abstract reasoning capabilities. The project staff seems to have been unaware of the developments of educational research even though very important components of this research were (and still are) performed at the Lawrence Hall of Science in Berkeley, California, the same city in which the project staff is located. If science educators had been more involved in this project, they would have certainly made an effort to inform the staff of these considerations.

Even with all of the serious deficiencies of the project, it is not without merit. The project staff has developed in a manner interesting to me many topics not usually treated at this level. As a teacher I would certainly like to introduce some of them into my courses. However, I could never use all of the materials nor any of the materials in their present form. I recommend that the materials be revised in modular form and in a presentation consistent with our present knowledge of students' intellectual development. This revision should not be performed by the present project staff but by professional educators with the assistance of secondary, community college and college instructors.

D. 19. a: SB: NSF Descriptive Information

PROJECT TITLE: Four Motion Pictures in Social Biology (SB)

PROGRAM: Science Curriculum Development

PROJECT DIRECTOR: Edward Kormondy/L. Eugene Cronin

INSTITUTION: University of Maryland

DEPARTMENT: Natural Resources Institute

BUDGET: Total Granted: $223,200

Dates: 5/26/71 - 6/30/75

PROGRAM OBJECTIVE: Science Education Improvement

PROJECT OBJECTIVES: Development of four films dealing with the social and ethical implications of new knowledge developments in the life and social sciences. The films are intended primarily for use at the secondary school level.

PROJECT SUMMARY

OBJECTIVE:

Development of four films dealing with social and ethical implications of new knowledge developments in the life and social sciences. The instructional films are intended to supplement existing biology curricula at the secondary school level, to supplement courses in the social studies, or to form the basic matrix of a new kind of secondary course in social biology.

ACTIVITY PLAN:

Script conferences were initiated immediately after funding was obtained. Four scripts were developed more or less concurrently; all were in mind at one time although the logistics precluded all four being developed simultaneously. As soon as the first script was approved, shooting commenced. Some shooting had to be planned on a seasonal basis.

Successful production of films of this type was dependent upon the use of a small continuing group of competent and dedicated film makers who are biologically oriented. Fortunately, such a group was available, and remained intact for the complete production period of two years.

ORGANIZATION AND MANAGEMENT PLAN:

1. Dr. Edward Kormondy, Co-Director of the Project, acted as editor-in-chief for this program. In this capacity he attended, with Erik Cripps, the film producer, all script conferences. One additional person was chosen according to his special competence for each proposed title to contribute knowledge and understanding of his discipline. The University of Maryland designated one person, Tom Wisner, to act in liaison with the project. These four persons constituted the Film Committee.

2. After initial discussion (a) other members of the Technical Committee were consulted and (b) other authorities approached for specific conference or participation.

3. A film treatment was then drafted and circularized to the Technical Committee for evaluation.

4. A working script was then developed by Erik Cripps and put into production. More than one film was developed concurrently. Aid was requested from all committee members for special production needs (locations, special film footage or the whereabouts of stock footage that might be available).

5. The film was edited and a working narration developed. This was screened with the Film Committee and amended as necessary.

6. The workprint and a recorded scratch track were screened synchronously (interlock) for the entire Technical Advisory Committee. Final editing was effected according to their recommendations.

7. A Teacher's Guide was developed. Dr. Jerry P. Lightner, Executive Secretary of the National Association of Biology Teachers, agreed to act as a major contributor to this phase of the project. He was assisted notably by high school teacher Roberta Higginbottom and Emily Cripps, project staff.

UTILIZATION PLAN:

The prime use of this film series will be for distribution to the school systems. The target audience is tenth to twelfth grade biology students. However, small samples of teachers have indicated their interest for use in all school science classes, as well as courses in social studies. Evidence also indicates that limited use could be made as early as third grade and full use at college level.

It is the opinion of the Technical Advisory Committee that where biology constitutes the only science course for the student, it is far more important that he should have an opportunity to experience materials such as this series than become constrained by a rudimentary knowledge of morphology, phylogeny, and classification. This has been practiced too much in

the past in secondary school biology. It is further felt that the series can be a vital educational experience for many adult audiences.

With the completion of the films, it seems certain that educational TV distribution can be arranged.

HISTORY AND RELATED PROJECTS:

With the advent of the Biological Sciences Curriculum Study, discussions were instituted as to new film material relevant to an age of biological revolution. Two consultants, Dr. Ted F. Andrews (Dean, Governors State University, Forest Park, Illinois, and formerly Director of Science, Educational Research Council of America, Cleveland) and Dr. Thomas Overmire (Director, Michigan Academy of Science) - both of whom had been associated with BSCS - met with Erik Cripps, a trained social biologist who is now a filmmaker, and script conferences began. The resulting conclusions: that there was desperate need for interdisciplinary instruction; that only a comprehensive series of films was adequate to interpret a holistic viewpoint, and that our concern must be with nothing less than the total ecology of Man. A Film Series in Social Biology was therefore planned. From numerous suggested titles, four were chosen, scripted and produced. Those completed are:

1. Check and Balance in Nature
2. Energy in Life
3. Man's Impact on the Environment
4. The Ascent of Man.

As a result of this beginning endeavor, a Technical Advisory Committee was convened under the chairmanship of Dr. L. Eugene Cronin of the Natural Resources Institute, University of Maryland. The Committee met, reviewed the films and concept, and unanimously endorsed the continuance of this Film Series in Social Biology.

Seven members of the Technical Advisory Committee then met and considered the next film titles that would most constructively implement the Series. Four additional titles were chosen and potential content material was tentatively defined. Four brief outlines were then submitted to the Committee and approved in principle.

It was therefore proposed to continue this Film Series in Social Biology with the four following titles, which became the focus of this curriculum development project:

1. Behavior
2. Communication
3. Death--An Invention of Life
4. Technological Man

PERSONNEL:

PI/PD:

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Olympia, Washington

CO-PI/PD:

Dr. L. Eugene Cronin
Natural Resources Institute
University of Maryland
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OTHER:

Technical Advisory Committee
(at start of project)

Dr. Robert Bell
School of Architecture
University of Maryland

Dr. L. Eugene Cronin, Chairman
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Dr. Victor C. Ferkiss
Department of Government
Georgetown University

Dr. Murray Gendell
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Dr. Edward Kormondy
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Mr. William Lee
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Dr. P. Alan Boneau
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Dr. Elwood Ehrle (then of)
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Mr. Thomas A. Wisner
Conservation Education Specialist
Natural Resources Institute
University of Maryland

Dr. Martin W. Schein
Centennial Professor of Biology
West Virginia University

Mr. Robert Wistort
Beltsville High School
Beltsville, Maryland

Production Personnel

Erik Cripps. (BSc, Kings College, England) produced, wrote and directed the films. Mr. Cripps' experience has included: a Nuffield Foundation Grant to set up the first Audio-Visual Department at Oxford; positions in the film industry as producer, director, writer and film editor for feature, documentary and TV. He has operated as an independent producer under the name of Biofilms for the last fifteen years. Biofilms has produced educational film series for McGraw Hill, Encyclopedia Britannica, Universal Education, modern learning aids and the Office of Education, etc.

Emily Cripps. (BA, Biology and Philosophy, Bryn Mawr). Miss Taylor is a professional film editor (CBS, NET, Gifford Productions, etc.) who has been staff editor for Biofilms for the past four years.

Richard Burris. (BA, Western Maryland, Biology major, Dramatic Art minor). Mr. Burris taught school biology for three years. He joined Biofilms as a staff production assistant to work with us on the present series.

D. 19. b: SB (Panel 5): Project Director's Response to 10 Review Questions.

NSF Staff Note: The project director for the Social Biology Films project responded with a letter referring to portions of the teacher's guide, a product of the project, for responses to the review questions. This material is not reproduced here.

Comment by the Project Director: Due to the press of time, there was no project staff member who could be detailed to complete the extensive questionnaire in the allotted time.

D. 19. C: SB (Panel 5): Panel Responses to 9 Review Questions

Question 1: Is there a genuine need for these instructional materials?

Based on the information presented, it is not clear that a comprehensive needs assessment was conducted for this project. However, it was generally agreed by members of the panel that these types of films are needed in secondary education. At present, there is a limited quantity of similar instructional material available in this area. Most of the existing materials on bio-ethics are in film loops, 35 mm slides and textual materials. There is a place for more instructional materials such as films in this area.

It is not clear how many schools would utilize these films since some controversial and provocative topics are included.

In summary, these instructional materials treat socially significant topics. However, in many communities throughout the nation these materials may not be accepted readily. Despite this fact, it is imperative that these types of materials be prepared in order to cope with the technological gains that require crucial decision making on the part of society and its members.

Question 2: Is there a market for these instructional materials?

Very few other materials exist to achieve the goals of these films and, as such, there is room in the present curriculum for these materials.

There is no project dissemination plan and no free market response is known. However, the panel members generally agree that if these materials are to establish a market, a considerable effort must be made to establish an orientation and awareness program for both the teachers and the members of the community in which they are to be used.

Although no publishers' commitments or market studies are available, implementation would be strengthened by a substantial teachers' manual designed to handle the nature of questions which will be raised and to prepare the school system for possible concerns of community leaders and special interest groups.

In summary, the market for these materials revolves about a very important question, "Are school systems prepared to introduce socially-sensitive materials into the curriculum?" Acceptance is likely to be conditional and selective in some areas. There would probably be little impact of these instructional materials on those already in the market place. There seems to be little or no overlap with available film material.

Question 3: Do these instructional materials possess a clear purpose and rationale?

The original project proposal recognized a dearth of instructional materials dealing with bio-ethical information. At the same time, the proposers noted, correctly, that the study of bio-ethics was an emerging area of science. The films that were developed were designed to stimulate student thought and questions about their bio-ethical surroundings.

More inferred assumptions and values are contained in the four films than we can possibly list. The two films entitled "Technological Man" and "Death--An Invention of Life" contain the larger proportion of provocative and stimulating questions and issues. Every group viewing these films will undoubtedly find material to stimulate their scientific and social conscience. Local needs may be fulfilled by the use of these types of films with appropriate discussion and supplemented with newly-developed textual materials.

The committee does not feel that the film series could stand as an independent module. For more effective utilization, the panel reccmmends that a teacher's guide be developed to supplement the film. It also recommends that a sequence of the films be:

(a) "The Animal Worldview"

(b) "Man, the Symbol Maker"

(c) "Technological Man"

(d) "Death--An Invention of Life"

Question 4: Is the content of these instructional materials scientifically correct?

The films are aimed at creating a population which is scientifically literate in particular areas of social, cultural, and ethical implications of recent advances in biological science. The films present an evolutionary approach to explaining behavioral patterns of living organisms. These explanations proceed from the more simple forms of life to those processes which encompass man. The latter processes include man's aspirations, the means of communicating them and the conflicts which may arise in fulfilling them.

All review panelists agreed to the accuracy from the natural sciences' point of view. There may be a need for a response from social scientists. The ideas presented are undated, but since science is involved, the ideas will require updating commensurate with new knowledge.

The breadth of coverage in the films fell far short of that described in the authors' informational brochure available to the reviewing panel.

In summary, the films were judged scientifically correct.

Question 5: <u>Is the content of these instructional materials educationally sound?</u>

Adverse reaction to the films could result from the questioning of religious, social, cultural, economic, technological and philosophical traditions. Favorable reaction could come from the stimulation of curiosity and thought processes. Questions are raised which are points of departure for extensive interchange of ideas. The issues are of high interest for reflective students of all ages.

Film content is such that it could pose difficulties in both cognitive and affective domains for some students. The tripartite format is ingenious and the suggested uses, the presentation of the concepts and questions, and suggested readings are useful. In short, the films should have general effectiveness.

The review panel believes that the teacher's guide offered the only instructional aid available and that it was not adequate. A well-developed guide for teacher direction in dealing with value-laden areas which these films emphasize would be in order.

In general, the materials are educationally sound. The quality of the production could be improved and more effective teacher preparation materials are needed.

Question 6: <u>Are the proposed and anticipated outcomes of the instructional materials desirable?</u>

The anticipated outcome of these films is to stimulate thought concerning many ethical questions that biological and social scientists must consider. Obviously, there will be a great variation according to participant. The materials may prove too value-laden for some school systems, yet may serve as important developmental tools in others.

The intended effect of raising questions concerning bio-social, ethical issues will be met. In addition, the lack of closure--that is, open endedness--in the films cannot help but serve as an interface to real-life situations. An unintended effect of the material will likely sensitize certain ethnic, racial and/or religious groups. There is racial and ethnic stereotyping in some scenes.

Unless clearly stated in the teacher's text, some may feel the need to bring closure to the issues raised, which would undermine the project goals. The important process features include the stimulation of thought in the area of bio-ethics. There is a need for more adequate delineation of goals to teachers in the guides. The outcomes of the project are highly important. Efforts should be exerted to alert teachers of the goals of the films. Certainly, many questions were raised.

The anticipated outcome as described in the film brochure is to raise questions concerning bio-ethics. The films accomplish this goal in a stimulating manner which could be potentially controversial.

Question 7. Do these instructional materials present implementation problems to the schools?

The review panel concluded that the teacher needs background material on the issues involved and their relation to the religious, social, cultural, and economic milieu of the community, on group dynamics training, value clarification techniques, and on community relations.

The materials deal with evolution and value questions and set the tone for discussion which potentially creates a platform for critics within the community. The nature of the material and its presentation seem slanted toward the bright and interested student. However, with proper preparation by the teacher, a large segment of the student population could be involved.

These materials can be integrated into already existing courses or programs and would not, by themselves, serve as a total curriculum.

In summary, several potential barriers to implementation were identified: (1) inadequate teacher preparation and attitude, (2) negative student reaction, and (3) poor handling of questions arising from curiosity generated by the films, and (4) negative community reaction and unwillingness of the administration and staff to have a dialogue with the community. The barriers are proportional to the relationship between community values and school values. Adult and peer acceptance of the question and the questioning process could prevent polarization and remove some of the barriers.

Question 8: Are the costs for implementing these instructional materials reasonable?

The expected dollar costs for the films are between $300 and $400 per film and rental prices probably about $25 per film. Once the films are purchased, the cost of implementation will be in orienting new teachers and making parents aware of the issues.

An additional cost may be incurred if the community chose to employ outside consultants to lead discussions with parent and/or teacher groups. If the resource person must travel a long distance, she or he may require funds which are a significant cost. The school district could arrange panel discussions of local resource people, e.g., ministers, doctors or elected officials.

Some of the questions raised in the films have also been raised in a few public television programs, for example, "Civilization," "Nova," and "Ascent of Man." Tapes or films of these programs could be used if available. The costs of using local resource people or TV programs, if available, may be nominal.

The social/psychological costs to some members of a community could be very high. "Technological Man" and "Death--An Invention of Life" each raise questions which many students, teachers and parents are not prepared to consider.

In summary, there should be no problems of implementing these films in terms of cost once they are distributed.

Question 9: Is the management/organization plan adequate for producing these instructional materials?

Information on management/organization was requested from the project developer by NSF, but none was received. Thus, information was inadequate.

There is no information available to us at this time to indicate (1) outside input in development other than the advisory committee listed at the beginning of the film, (2) internal monitoring, and (3) the existence of independent external evaluators.

Based on the grant request total, the number of minutes of film footage produced, and the present cost of film production, there does not seem to be an overexpenditure for administration.

In summary, management/organization plans were not clearly stated in the proposal. Further, no information on these activities during production was available to the panel.

D. 19. d: SB (Panel 5): Individual Panelists' Responses to 10th Review

Question: What are your general impressions of the curriculum?

Panelist: Dr. Daniel F. Burton

Most educational agencies, local or state, have begun to question professional personnel about cost and effectiveness of programs. Shrinking enrollments, the slowing of national economic growth, resistance to taxes combine to give Congress, legislatures, and school boards the choice of cutting personnel, building, teaching materials, or some combination of these. To make choices of programs to cut or new programs to initiate, appropriation committees and boards need to know which programs or projects can be proved to have a positive value for students. The most effective way to obtain data on a program's value is to determine how students' skill level and/or attitude and/or behavior have changed as a result of participation in a program. NSF terminates its role just prior to dissemination which inhibits collection of such data. I recommend NSF budget for follow-up of disseminated projects to document successes (and to discover causes of failures, if any).

Panelist: Dr. Wayne E. Carlson

Youth today want to have an active part in the decision-making process in their communities and nation. They are very concerned about social issues and our educational institutions must continue to be sensitive to these needs. Educators sometimes occupy a very precarious position between the student and the adult communities and some educators do not always understand and appreciate the new image of youth. The parent who may have graduated from a more structured educational system may also need help in understanding the assertiveness of today's youth. Therefore the school oftentimes finds itself in an adult educational role. I feel this series of films entitled "The Science of Life," properly sequenced, can serve effectively in public and private education to acquaint both adult and youth with the issues of tomorrow and stimulate them to discussion.

Since there are several provocative ideas contained within this series of films, some of which may challenge basic institutions and mores, teachers may need to be helped to feel more comfortable with using group process skills, and values clarification techniques. They also need to be aware of and be equipped to help youth arrive at viable alternatives during these discussions. For example, what are the alternatives to a technology which is so basic to our way of life? Does man have a moral right to overcome death?

In general, the films are well documented although there are a few brief scenes that illustrate potentially sensitive areas that perhaps could have been photographed in a different way and yet retained their effectiveness.

Today's students are very receptive and sensitive, and like the adult community, are bombarded with a vast quantity of information which has an impact on their life. This series of films could and should be very effective in providing practical experience in a nonthreatening way to deal with some very real problems in management of human and natural resources.

Panelist: Sister Shirley Corbliss

These motion pictures fulfill a need that is becoming increasingly apparent in science education. With the advances in technology and the biological sciences it is necessary for the science educator to address her/himself to the cultural, social, religious, economic and philosophical implications of these advances. These films raise many of the questions that need to be addressed in a non-threatening manner.

The teacher will need special background in the cultural aspects of the community, community relations ability and value clarification techniques. I would welcome the opportunity to use these films.

I recommend the development of a teacher's manual which contains background material on the questions raised, a bibliography of related literature and media materials, and procedures for conducting value clarification sessions.

I recommend the inclusion of women and minority races in a more positive manner.

Panelist: Dr. Richard A. Dodge

My concern does not involve problems with the value content of the films even though some may submit that the materials could be sensitive to certain pressure points and/or closed attitudinal mentalities. The social issues raised certainly explore sensitive areas and issue foci; however, the manner in which this is done is not in the least offensive nor slanted. The films raise questions which should be approached by every thinking citizen regardless of persuasion. I strongly suggest that the films are quite appropriate for target audiences as well as adult and scientifically concerned lay citizenry. With the exception of role modeling or identity shortcomings I do not see these films as ethnically or racially offensive. I believe that the scientific content is accurate and the social issues raised (many, almost overwhelming) are appropriate and must be understood and explored in our society.

I do have some concerns with quality of work, particularly the media skill in execution. I would not recommend publication of the films in their present form because of this. The photography skill leaves much to be desired, i.e., problems with focus, rapid scanning of sequences, poor panning techniques, sloppy editing and audio-visual mixing. I recommend separation of value questions so users may stimulate discussion while a topic is fresh in the viewer's mind. There is much too much to cover in discussion if full benefit of experience is to be realized.

I cannot envision application of these media without a teacher preparation workshop (a must) and very likely the use of parent-teacher sessions to clearly explain and explore the social issues raised. Most teachers are frankly unequipped to adequately handle the materials.

Panelist: Dr. Roger W. Hanson

This project is not a curriculum nor was it intended to be. The films are meant to pose questions and to stimulate student "thinking processes." The content in and of itself appeared free of value judgement. However, the viewer is essentially forced, through objective thought, to confront some very basic issues which one frequently tends to avoid.

This panelist strongly agrees with the consensus of the panel that the films should be viewed sequentially, at least by most audiences. If not, many of the issues which should be faced objectively, may continually be avoided.

Panelist: Dr. Fred D. Johnson

I am generally impressed with the curriculum materials. I feel that proper sequencing of the materials would make them more meaningful to students and more acceptable to some communities.

I would recommend that the roles played by minorities in this series of films be revised. These scenes which include minorities tend to stigmatize them rather than encourage them to pursue technical and professional job training.

I would strongly recommend that a considerable amount of work and revision be done on improving the materials to be used by teachers with this series.

There was no evidence of a dissemination plan for these instructional materials.

Panelist: Mr. Andrew H. Miller

Bioethics is a topic that should be discussed in the schools and a definite lack of information in this field does exist. The "Science of Life" film series challenges the student with the science of bioethics and stimulates questions and general debate concerning important issues such as pollution, acceptance of death, and world destruction. The addition of role playing to the film intensifies the points in question and opens the door for student involvement. Some of the issues discussed or actually generally implied in the film are controversial and rub against the conservative opinions of educators. This controversy may be the very basis for student debate and thus enhance the learning experience.

Overall, the films are factually accurate and will hold the attention of the student. A definite criticism of the film series is a misrepresentation of minority races. Key scientific positions are not significantly divided among races in the film series. In addition to this problem a more in-depth teacher course profile should be provided. Special information pertinent to the discussion of the issues in the film series needs to be administered to the teachers prior to student viewing. The "Science of Life" teacher's guide does not include information needed by the teacher conducting the viewing session.

Overall, these films show a good deal of promise in the introduction of bioethics to the high school student. For maximum results the films should be viewed in the following order:

1) The World Without--The World Within
   a) The Animal Worldview
   b) Man, the Symbol Maker
2) Technological Man
3) Death--An Invention of Life

Panelist: Dr. Gerald A. Myers

The films are basically sound biologically and the social implications are good. However, no need was sought. Their development seemed to be based on a gut feeling that there was a place for this kind of film. There was no indication of plans for goals or objectives as outcomes of the film development.

The film guide was very weak and gave the teacher little guidance as to how to handle the films, before, during or after showing.

I recommend that the project staff submit a review to NSF.

Panelist: Dr. James M. Stevenson

The curriculum material presented in the biofilm series was of a high quality; however, the information was provided in a highly emotional manner. Stimulation of pupil reaction is assured by the sensitive nature of this material. Effort must be made to educate the public within a given school district utilizing these films concerning their nature and the manner of their presentation.

The values of a series of this type are multiple. The stimulation of young people, their resultant reactions, and a dissection of that, are valuable learning experiences. Several of the film presentations seemed burdened with highly volatile information and/or supposition. The fact that the film leaves to the discretion of the viewer and teacher/leader the direction of discussion will probably result in undue reaction in certain communities. However, this material should be provided for preview by parents as it is their responsibility to determine the nature of the level of sophistication of their children.

Panelist: Mr. J. Howard Straiton

As a Christian in a position of responsibility in a public school system, I have no quarrel with the premise of the series "The Science of Life." And, I recognize the content as not materially different than that which is now being used in texts and audio-visual materials in classrooms across the nation. The biological setting for arousing questions with profound social and spiritual implications is provocative in posing the very value related kinds of questions that people of all ages are asking. Our young people are seeking out adults who will help them find their answers--most realize their inherent personal right to a freedom of choice. The neglect of any persuasive introduction of religious beliefs can be justified by the doctrine of separation of Church and State but the camera closeup shot of three books; The Holy Bible, Karl Marx's Communist Manifesto and Adolph Hitler's Mein Kampf is an example of a "cheap shot" at Christianity. The narrator doesn't tell one what to think or feel but the biological science background leaves little in the way of those who propose nontheistic humanism or the biological morality suggested.

Panelist: Dr. Robert E. Yager

The films meet a real need and provide an exciting contribution to the field of biological education. The preparation of films in this area--although somewhat controversial--represents a needed resource for a modern biology course in the secondary school. The value of the films for general education in today's changing world is to be applauded.

The technical qualities of the films seem to leave something to be desired. After considering the "claimed" technical talent, it was disappointing to see the amateur production--and, at times, the quality of a home movie.

Generally, however, it is good that NSF support for such materials was made available. Foundation support should be pointing the way to satisfy national needs in science education.

Panelist: Dr. Dean A. Zollman

These films raise in an informative way the social questions and implications raised by modern biological technology. Since these films treat topics which all citizens should consider, they should be widely used. By the very nature of the topics they will be considered controversial by some people. Thus, the teachers using the films should receive some training in treating the topics in the classroom. Particularly, teachers must be sure not to state "answers' to the questions raised. Further, school officials should be encouraged to show these films to parents and other interested people prior to classroom screenings. To aid in this process the project staff should develop materials which will provide more background information for public consumption.

D. 20: Publishers Panel (Panel 7) Report

Panel 7 was composed of four representatives of the publishing industry who were asked to address Questions 1, 2, 7 and 8 (need, market, implementation problems, implementation costs) for ISIS and TPE. In addition, the Panel was asked to address a set of more general questions, which are set forth in Section D.20.c.

In addition, Panel 7 submitted the following general response:

An improved research base is needed for better and more precise R&D evaluations and commitments. At present, the educational publishers--including the NSF, curriculum groups, etc.,--have a very poor understanding of "what is out there." No one knows precisely (within 10% accuracy) for example, how many students are in the 10th grade biology course, how many students take 9th grade algebra, how many in 11th grade American history. Only with some state adoptions do we get an idea of what schools do, or at least buy. The ERIC group at the Ohio State University in 1971-72 conducted a research study of secondary science that was substantial in method and result. It is our feeling that a continuing effort to obtain firm market research information will be of benefit to all who make curriculum development commitments.

In the interest of bringing teachers the most comprehensive knowledge possible and making the broadest impact of NSF monies, we recommend that NSF support university-run teacher education institutes that consider all available materials, both commercially and NSF-created. The chief emphasis should be on upgrading teaching skills and expansion of content knowledge.

D. 20. a: Publishers Panel: Responses to questions about ISIS

Question 1: Is there a genuine need for these instructional materials?

At the time the project was proposed the needs assessment was, in our opinion, realistic. We see a continuing need for material of this kind (individualized, broad-appeal programs); however, we are not able to project the potential market acceptance.

We feel that it is important to society to have a scientifically literate citizenry. ISIS seems to be a significant step towards reaching students not now enrolled in science courses.

Question 2: Is there a market for these instructional materials?

At the present time there is no general curriculum slot for this material. However, it may fill certain specialized local needs.

It is our experience, that unless the NSF mounts an implementation program comparable to previous curriculum projects, that such a slot has little likelihood of being created.

The potential market impact of ISIS should be assessed in two ways: instructionally and financially.

1. Without doubt, ISIS will influence the future instruction of all students in secondary science. The depth of this influence will be largely dependent on the extent of the NSF support mentioned above.

2. With a limited amount per pupil to expend, inevitably the funds to purchase ISIS will come from losses to existing or new competing programs.

Question 7: Do these instructional materials present implementation problems for the schools?

One of the major barriers to acceptance in over twenty-five states is the state curriculum requirements. In addition, these states have stringent physical requirements which favor hard-bound textbooks.

Another problem ~~is~~ that of teacher acceptance. ISIS requires major changes in the ways teachers teach and students learn. Therefore, special teacher education is required for proper implementation.

Because of the large number of content options, local districts can design an ISIS offering to fit their own needs and desires.

Question 8: Are the costs for implementing these instructional materials reasonable?

It has been our experience that the cost of implementing innovative programs is higher than conventional ones. Thus, while unable to evaluate the figures supplied by ISIS, we are doubtful that ISIS can be implemented for less than the cost of a conventional program.

To our knowledge, there is no standard "reasonable" cost for implementing secondary science curricula.

D. 20. b: Publishers Panel: Responses to questions about TPE

Question 1: Is there a genuine need for these instructional materials?

There was agreement that there is a need for activity-centered programs for the target population. We also feel that it is important to society to have a scientifically literate citizenry.

However, the Panel felt that the material in Living in A Changing World: Unit 1, People and Technology was much too dense in concept load and had much too difficult a vocabulary load for the stated target population. We also question whether the pre-professional focus of the program is appropriate for the target population.

Question 2: Is there a market for these instructional materials?

We feel that there is a discrete market for materials to reach the underachiever who does not benefit from the usual classroom materials and strategies. This student population can identify with activities about their world which involve real problems and their judgments.

However, we felt that these materials are so wide of reaching this population that there is a serious doubt in our mind about their marketability.

Filmstrip packages generally do well in the marketplace. We do not feel that even this positive feature will overcome the unsuitability of the material for the target population.

Question 3: Do these instructional materials possess a clear purpose and rationale?

We felt that the stated rationale of the TPE materials is at wide variance with what appears in the materials. Our assessment is that the materials are in part most appropriate for pre-professional training of mathematics and science majors.

Question 7: Do these instructional materials present implementation problems for the schools?

We feel that the TPE Unit, People and Technology will need implementation help in the schools that buy the unit. The classroom method as outlined in the Teacher's Guide, is by itself, not sufficient to implement the program. The units requiring the circuit board and/or the computer would definitely need consultant service to orient the teacher.

We feel that unless implementation-consultants for TPE are funded, the materials as they now exist would be difficult for teachers to use with no TPE training.

Question 8: Are the costs for implementing these instructional materials reasonable?

On the surface, the cost of installing TPE in a school seems to be reasonable. However, there are also implementation costs for teacher education and costs of duplicating the spirit-master materials and other hidden costs we cannot anticipate. Therefore, we cannot adequately evaluate the implementation costs of TPE.

D. 20. c: Publishers Panel: Responses to five additional questions

Question 1: What impact have the funding practices of NSF's pre-college implementation program had on the supported educational materials and their publishers?

The NSF's pre-college implementation program for the supported educational materials and their publishers has in general been beneficial both educationally and financially to those publishers. However, it should be realized that only the successful bidding publishers can say this. The companies who did not acquire an NSF program were inhibited in their desires and efforts to develop competing programs.

Question 2: What has federal funding (and, specifically, NSF funding) for curriculum development added to education that might not normally have occurred in the commercial sector? Does federal funding inhibit the growth of the commercial sector?

We all see that the NSF pre-college educational materials have had a significant impact on the commerical sector. However, we feel that if the NSF programs in science did not exist, that other innovative science programs would have been developed--although over a longer time period.

The educational publishing industry is very competitive. In a number of curriculum areas such as elementary mathematics, elementary reading, etc., the private sector has done many significant new programs.

Question 3: Are there better ways for NSF to support curriculum development by working more closely and directly with publishers?

It is our feeling that the NSF curriculum support in the future should follow an SMSG model that is, support of basic research and development with the output and products placed in the public domain. Further, we feel that the NSF should attempt to deal with educational research--science pedagogy, science content--and publish the research for all. Also, we hope that the NSF would consult with all sectors of the educational world including educational publishing about potential directions to take.

Question 4: What is the economic status of the industry? Can they now support curriculum R&D projects of reasonable sizes?

The educational publishing industry in general is healthy. Many factors affect the industry. Our costs in terms of paper, printing, gasoline for sales representatives cars, etc., are all increasing rapidly and we are able to change our price effectively only once a year. Also, state adoptions require a guaranteed price which generally exists for five years or more.

Original research and development money is still scarce. We do not have the general capability to fund this and would like to see the U.S. Government work with publishers and curriculum groups to produce new materials.

Publishers are able to publish new curriculum projects and will probably continue to do so. But the previously mentioned increasing cost factors impede such development.

Question 5: <u>If not, what are the barriers to more R&D in the private sector?</u>

Question 5 is responded to in Question 4.

APPENDIX A

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4701 Kenmore Avenue #616
Alexandria, Virginia 22304
Recommended by: National Council for the Social Studies

Dr. Ethel Tobach
American Museum of Natural History
Central Park West at 79th Street
New York, New York 10024
Recommended by: American Orthopsychiatric Association

PANEL 4

Facilitator:
Dr. Roosevelt Calbert
Office of Program Integration
National Science Foundation

Dr. Jacob W. Blankenship, President
Association for the Education of Teachers of Science
344 Farish Building
University of Houston
Houston, Texas 77004
Recommended by: AETS

Dr. John Borriello
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Saint Elizabeth Hospital
2700 Martin Luther King Jr. Avenue, S. E.
Washington, D. C. 20032
Recommended by: American Group Psychotherapy Association

Dr. Scott Chalfant
353 Wisteria Avenue
Las Vegas, Nevada 89107
Recommended by: National Association of Secondary School Principals

Dr. Donald Dean
168 Fourth Avenue
Berea, Ohio 44017
Recommended by: American Institute of Biological Sciences

Mrs. Ruth Ganong, President
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710 Hillside Avenue
Albany, California 94706
Recommended by: Local School Superintendent

Ms. Sarah Hurst
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Recommended by: American Society of Medical Technology

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Recommended by: American Physical Society

Professor Robert A. Peura
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Mr. Harold Pratt
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Science Education Department
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Recommended by: National Science Teachers Association

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Recommended by: Administration and Faculty, Wilson High School

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Orland Park, Illinois 60462
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PANEL 5

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National Science Foundation

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4-H Youth Development
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Recommended by: 4-H National Foundation

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Recommended by: National Science Teachers Association

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Recommended by: American Institute of Biological Sciences

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Birmingham, Alabama 35294
Recommended by: National Science Teachers Association

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Science Consultant
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Recommended by: National Science Teachers Association

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Recommended by: Administration and Faculty, H.S. for Health Profession

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Recommended by: American Institute of Biological Sciences

Dr. James M. Stevenson, Director
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Charleston, West Virginia 25330
Recommended by: American Pshchiatric Association

Mr. J. Howard Straiton, Principal
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Recommended by: National Assn. of Secondary School Principals

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Recommended by: National Science Teachers Association

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Stony Brook, New York 11794
(On leave from Kansas State Universit
Recommended by: American Association of Physics Teachers

PANEL 6

Facilitator:
Mr. Howard P. Levine
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National Science Foundation

Dr. Ted F. Andrews, Dean
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Dean Elwood B. Ehrle
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Mankato, Minnesota 56001
Recommended by: American Institute of Biological Sciences

Mr. William E. Galbraith
American Legion
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Recommended by: American Legion

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University Park, Pennsylvania 16802
Recommended by: American Physical Society

Dr. Hilliard Jason, Director
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Assn. of American Medical Colleges
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Washington, D. C. 20036
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Mrs. Elaine W. Ledbetter, Head
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Mr. Kevin McMahon
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Recommended by: Educational Products Information Exchange

Ms. Mary C. O'Brien
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Recommended by: Local School Superintendent

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Recommended by: American Institute of Biological Sciences

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Recommended by: Council of State Supervisors of Social Studies

PANEL 7

Facilitator:
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Mr. Carl Gulbish
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Mrs. Norma Markson
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Mr. William Moore
Executive Editor - Science School Department
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New York, New York 10025

All Panelists Recommended by Association of
American Publishers

APPENDIX B

CHRONOLOGIC AND DESCRIPTIVE DATA

Appendix B: Chronologic and Descriptive Data

Initial notification of the intention to perform the review of NSF-supported curriculum efforts was made to the National Science Board on October 18, 1975 by Dr. Harvey Averch, Acting Assistant Director for Science Education. Planning efforts within the Foundation between this date and the completion of the review are detailed in this appendix.

CHRONOLOGY OF EVENTS LEADING TO THE REVIEW OF NATIONAL SCIENCE FOUNDATION SUPPORTED CURRICULUM EFFORTS

June 19, 19 House Committee on Appropriations for Department of Housing and Urban Development - Independent Agencies forbids National Science Foundation implementation activities for FY '76. (House Report 94-313)

"Regardless of the merits of a particular course of study, the Committee believes that the provision of federal funding for unique educational marketing activities tends to give particular courses unfair advantage in the market place and therefore it is of extreme importance that federal intervention in the development of curriculum, and especially in its implementation, be fully justified on a course-by-course basis to the Congress and to a broad base of public, educator, and professional organizations and parent groups nationwide." (p. 35)

"Since the Foundation is currently developing a number of courses...which have never been reviewed by the Committee in terms of their national need, the Committee has included no funds for the implementation of courses in 1976. This will give the Foundation time to prepare the necessary data and to fully inform the Congress and the public of its intentions and the basis on which it has determined the pressing need for such course material. It will also give the Congress time to fully evaluate the impact of federal involvement in this field and arrive at effective public policy guidelines for the development and implementation of such materials." (pp. 35-56)

June 20 Policy Statement approved by National Science Board

POLICY STATEMENT ADOPTED BY THE NATIONAL SCIENCE BOARD AT ITS 174TH MEETING ON JUNE 20, 1975 ON NSF IMPLEMENTATION OF SCIENCE CURRICULA

"Prior to undertaking full-scale dissemination and assistance activities for NSF-developed materials, NSF should undertake a careful review to ensure that the proposed subject matter fits within reasonable limits or norms with respect to educational value and that the scientific

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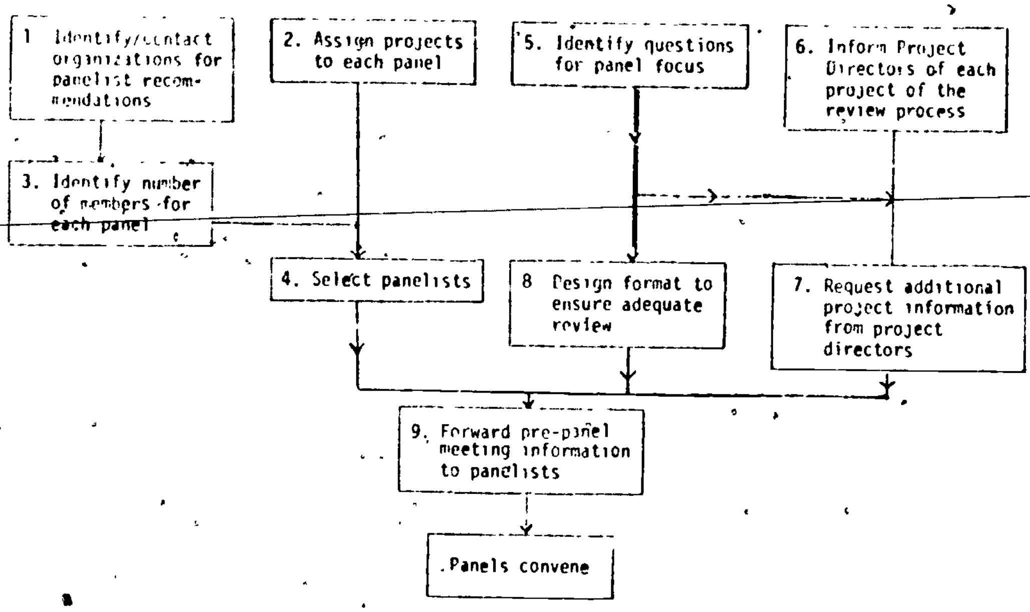
content is accurate. Recognizing the broad base of concern with elementary and secondary education, the Foundation should provide opportunities ~~for~~ input in this review by representatives of the scientific, educational, child development, commercial publishing, and informed public community."

October 18	Dr. Harvey Averch, newly appointed Acting Assistant Director for Science Education, announces to National Science Board plans for immediate curriculum review based on the Board's June policy statement.
October 23-November 11	Dr. Averch and Dr. Jack T. Sanderson, Acting Deputy Assistant Director for Science Education, meet with Congressmen and staff members about the review plans.
October 23	Dr. Averch appoints Task Force ~~on Curriculum Review~~ to complete plans for the review.
October 23	Letters forwarded to the directors of sixteen curriculum projects presently funded by NSF signifying the intent to review project efforts.
October 30	First draft of review questions reviewed within AD/SE.
October 31	Curriculum projects assigned to panels.
October 31	Press Release announced the review.
November 3	Organizations selected to contact for possible panelists.
November 3	Decision made to review three additional curriculum projects (Science Biofilms, Arithmetic Project, Madison Mathematics Films).
November 4	Letters forwarded to three additional curriculum project directors informing them their curriculum efforts would be reviewed.
November 6-7	Advisory Committee for Science Education meets in Washington. Review performed by Committee on the questions to be used in the review.
November 10	Letters forwarded to nominating organizations seeking their nominees for the curriculum review.
November 10	Final draft of review questions completed.

November 11	Letter forwarded to project directors of the nineteen projects requesting their answers to the review questions as well as provision of additional materials for panelists to review.
November 12-17	Nominations for panelists received from organizations.
November 18	Initial selection of panelists based on organizations' recommendations.
November 18-24	Additional materials and answers to review questions received from project directors and staffs.
November 18-28	Telephone invitations extended to prospective panelists followed by mailings of necessary NSF travel forms and consultant agreements to those accepting.
November 26-December 1	Pre-panel meeting materials forwarded to panelists.
December 3	Letters forwarded to project directors identifying final plans for review and list of panelists.
December 8-12	Curriculum Review
December 12-January 24	Drafts completed on all panel reviews.

PREPARATORY PROCEDURES

Prior to the convening of the panels on December 8, 1975, nine planning steps were taken as shown in the diagram.



1. Identify and Contact Organizations for Panelist Recommendations

The National Science Board in its policy statement of June 20, 1975 concerning curriculum review directed that the Foundation undertake a "careful review to ensure that the proposed subject matter fits within reasonable limits or norms with respect to educational value and that the scientific content is accurate." The Board further noted the need for a broadly-based review, with input from the "scientific, educational, child development, commercial publishing, and informed public communities."

Based on the Board's charge for a broadly-based review, it was determined that panels should include representatives from the following groups:

A. Scientists/Mathematicians
B. Professional Educators
   1) Elementary/Secondary Teachers
   2) School Administrators
   3) Science/Mathematics Supervisors
   4) Science/Mathematics Educators in College Settings

C. Child/Adolescent Development Specialists

D. Commercial Publishing Representatives
E. Informed Public Communities

   1) Parents and other interested lay citizens
   2) School Board members

F. Students*

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* While the Board charge did not request student input, student involvement in the review process was deemed important. However, in panels where elementary or early secondary school materials would be reviewed, no student representation was considered necessary or advisable.

The next step was to contact sources of possible panelists. Although the review was to be for NSF use, it was decided to request representative organizations to nominate panelists rather than for the Foundation to select individual panelists.

A number of well known professional groups were invited to recommend panelists, to insure representative populations. In addition, in cases where a group whose opinions were considered important by the Foundation existed, it was selected for contact even though its total membership was small. This latter rule was invoked to gain a more diverse sample of parents and lay representatives.

Fifty-three organizations were selected for initial contact. Letters to presidents or executive directors of these organizations were mailed on November 10, 1975. Organizations and their addresses are listed in Exhibit B-2. The letter used is exhibit B-1.

It was decided that students would be selected by teachers and administrators of individual schools. For convenience, it was decided that two students be recommended from Woodrow Wilson High School, geographically closest to the Directorate for Science Education offices in Washington, D.C. It was also decided that a student in a special high school for the health professions should be invited. Administrative officials and teachers in the Houston (Texas) Independent School District were asked to nominate a student from their nationally recognized High School for the Health Professions.

While the contact groups were numerous, difficulties in receiving either recommendations from groups or the consent of contacted panelists made it necessary to contact additional potential panelists. This contact was needed to ensure unique skills. The Association for the Education of Teachers of Science, a professional group associated with the National Science Teachers Association, was contacted in late November and two

panelists were selected to represent college-based science educators. A similar contact with the National Council for Social Studies generated two additional panelists. In addition, because of timing and scheduling conflicts, there was difficulty in obtaining panelists to represent school board membership. To ensure a more balanced geographic distribution of panelists, two school superintendents from western states were asked to recommend school board members.

After learning of the review, two other groups recommended panelists. The Council of State Social Studies Specialists recommended members and Dr. Onalee McGraw, Legislative Chairman, National Congress for Educational Excellence and Coordinator, National Coalition for Children, contacted the Foundation to recommend panelists.

2. Assign Projects to Each Panel

In all, there were 19 curriculum projects selected for review. Each was supported by a grant from the National Science Foundation and all were in different stages of development. Some developers had completed their projects but had not yet terminated their grant with the Foundation. Other projects were in the initial stages of development, others in the middle phases. Some projects were funded for multi-year efforts, at a cost of over 1 million dollars; still others were smaller projects, costing less than 75,000 dollars total.

In planning the review, several dimensions were considered in the identification of numbers and types of panels. It would have been possible to have panels look at the projects: (a) by developmental stage; (b) by subject matter; (c) by the grade level they were designed for; or (d) by level of funding. Instead, staff members chose to combine several of the criteria in the making of panel assignments. The listing below notes the rationale for the inclusion of projects within the panels:

Panel 1: Elementary Mathematics Projects

All are aimed at the K-6 grade level. However, there are different levels of funding and different stages of development represented. One project, Unified Science and Mathematics for the Elementary Schools, is an interdisciplinary effort with both science and mathematics. However, it is K-6 in nature.

1. Unified Science and Mathematics for the Elementary Schools (USMES)
2. Problem-Solving Strategies and Applications of Mathematics in the Elementary School (MPSP)
3. Project for the Mathematical Development of Children (PMDC)
4. Arithmetic Project (AP)
5. Madison Project Films (MMP)

Panel 2: Secondary Mathematics Projects

The projects are in different stages of development but all are secondary mathematics efforts.

1. Sourcebook in Applied Mathematics (SAM)
2. Creation, Testing and Dissemination of Problem-Solving Instructional Materials (PSIM)
3. Development of a Mathematics Program for Grades 7-8 (MP78)
4. Mathematics Resource Project: Topical Resources for Middle School Mathematics Teachers (MRP)
5. First-Year Algebra via Applications Development Project (FYA)

Panel 3: Social Science Projects

The three projects are diverse in their content and developmental stages but are all secondary school social science efforts.

1. Exploring Human Nature (EHN)
2. Human Behavior Curriculum Project (HB)
3. High School Political Science Curriculum: Comparing Political Experiences (CPE)

Panels 4, 5, 6.

There was a conscious decision to ensure that a number of the more complex projects were reviewed by more than one panel. All of the projects here are for use in secondary schools and are not social science efforts. Most of the efforts are in the middle or later stages of development and, hence, would provide a larger amount of materials to be reviewed.

1. Technology, People, Environment (TPE) - Panel 4 only
2. Individualized Science Instructional System (ISIS) - Panels 4, 6
3. The Biomedical Interdisciplinary Curriculum Project (BICP) - Panels 4, 5
4. Four Motion Pictures in Social Biology (SB) - Panel 5 only
5. Outdoor Biology Instructional Strategies (OBIS) - Panels 5, 6
6. Human Science Program (HSP) - Panel 5 only.

Panel 7: Publisher's Panel

It was felt that the publishing community would provide valuable feedback on those projects whose developmental cycle has reached the stage of commercial distribution and whose directors had negotiated contracts with publishers. Only two of the 19 projects met these criteria and were reviewed by this panel.

1. Individualized Science Instructional System (ISIS)
2. Technology-People-Environment (TPE)

3. Identify Number of Members for Each Panel

The National Science Board's position on the review was that there should be a broadly-based representation on each panel. Therefore each panel was to include representation from science/mathematics communities, and include professional educators, child/adolescent development specialists as well as have input from parents and other informed citizens. On those panels where their input was considered relevant, students were recruited. The separate panel of publishers was convened to meet the request that commercial publishers view the materials.

In addition to these global panel needs, each panel had unique requirements. Panel 1 was to address several research-oriented efforts, so those mathematics educators chosen had to be able to reflect on the research effort as well as the product. In addition, Panel 1 was viewing a unified science/mathematics effort. Therefore a college-based science educator was deemed necessary. Teachers were chosen in order to achieve classroom perspective.

Panel 2 required the input of secondary education personnel.

Panel 3 personnel were chosen to reflect broadly-based expertise in all of the social sciences. In addition, because of the possible controversy associated with the development of any social science materials, it was considered germane to include a larger percentage from the parent/informed public sample.

Panels 4, 5 and 6 called for a broadly-based representation but the strengths needed were to be found primarily in the science community. Panels 4 and 5 called for panelists who could view the Biomedical program, hence the addition of medical education personnel. Panels 5 and 6 called for a heavy representation of those with extensive knowledge of biological sciences.

In order to meet the requirements of the National Science Board and to meet panel needs as NSF staff viewed them, it was decided that each panel should have between 10-13 members except Panel 7, where it was felt that a smaller number of publishers could provide the input needed.

4. Select Panelists

In recommending panelists, the organizations contacted were asked to make their selection in administrative session rather than to poll their entire clientele. In addition, it was requested that the organization executive contact NSF staff members via telephone with nominees' names, addresses and telephone numbers. Each organization was asked to list its recommendations in order of priority.

In his November 10 letter to organizations requesting nominations, Dr. Averch asked that they respond by November 17. By November 19, 44 of the 53 organizations initially contacted had responded. Of this response group, 6 organizations explicitly declined to submit names. Thus, with names submitted by the two organizations contacted later and the two organizations volunteering names, panelists were selected from lists provided by 42 organizations.

Since the Foundation wanted panelists whose views would reflect those of the nominating organization, each organization was requested to nominate 6-10 individuals who fulfilled this criterion.

It was expected that a large number of nominees would be unable to participate because: (1) the panel reviews would be held less than three weeks after contact with nominated panelists was made; (2) unless they lived in the Washington area, there would be a one week time period during which the panelists would be away from their homes; (3) the one-week period was near the Christmas holiday season.

Organizations representing the needed panelists were randomized for final panelist selection. For example, in the pool that would provide parents, twelve source groups responded with recommendtions. These group names were randomly selected to identify who would serve on what panels A similar process was used to identify those groups that would be used for the selection of panelists to meet other necessary panel membership.

Individuals were then contacted by phone in order listed by their recommending organizations until successful contact and acceptance.

In those cases where organizations did not provide a priority listing, staff members attempted a "best guess" selection by matching the known background of an individual (data were provided by all organizations in their recommendations) with identified panel needs.

In cases where panel voids still existed, groups were asked to generate additional nominees. This experience was especially critical in the identification of mathematics educators at the elementary, high school and college level as well as of science teachers and supervisors. The National Council for Teachers of Mathematics and the National Science Teachers Association provided additional names.

As mentioned earlier, personal contact with superintendents, teachers and two professional organizations were made to fill final gaps in panel membership.

Panelists selected are named in Appendix A.

The final panel representation is shown in Table B-1, organizations providing nominees by number are shown in Exhibit B-3, and geographic distribution of panelists is shown in Exhibit B-4.

Table B-1. Panel Representation by Role

	Panel 1	2	3	4	5	6	7
Mathematicians	1	2					
Scientists			3	3	4	4	
Elementary Teachers	2						
Secondary Teachers		2	2	1	1	2	
School Administrators	1	1	1	1	1	1	
Mathematics Supervisors	1	1					
Science Supervisors			1	1	1	1	
College Mathematics Educators	3	1					
College Science Educators	1			3	1		
Child or Adolescent Development Specialists	1	1	1	1	1	1	
Publishing Representatives							4
Parents or Informed Citizens*	1	2	3	1	1	1	
School Board Members				1	1	1	
Students			1	1	1	1	
Total	11	10	12	13	12	12	4 = 74**

* Just as those individuals representing professional roles were, in many cases, parents, those people representing parents and other informed citizens served in other roles. An electrical engineer recommended by an organization in our parent and citizen pool was counted as a member of the parent and other informed citizen sample.

** One panelist did not attend due to illness.

5. Identify Questions for Panel Focus

The Directorate for Science Education was requesting a careful and critical review of nineteen curriculum projects presently receiving support from the Foundation or that were no longer being funded but were ready for dissemination. AD/SE staff compiled a list of critical questions for the panelists to aid AD/SE in planning future efforts related to the nineteen projects and other future curriculum support efforts of the Foundation.

The listing comprised nine major questions with sub-questions under each. In addition, a tenth "General Impressions" item was added to permit panelists to raise individual questions or express concerns or opinions not covered in the other nine questions. The initial draft of the instrument was considered at the Advisory Committee for Science Education meeting in Washington on November 6-7. With the major input of member Dr. Michael Scriven of the University of California, the instrument was revised for use in the December panel meetings. A copy is found as Exhibit B-5.

The publishers' panel was asked to address a sub-set of the basic questions considered by AD/SE staff to be most appropriate to its expertise. In addition, this panel was asked to address a set of five questions on the impact of NSF curriculum development activities on the publishing industry. A copy of these questions is found as Exhibit B-6.

6. Inform Project Directors of each Project of the Review Process

On October 23, Dr. Harvey Averch forwarded a letter to the principal investigators of the sixteen active projects - projects with obligations or outlays from the Foundation during the current fiscal year. This letter, Exhibit B-7, gave notification of the review. A request was made that project staffs ensure that a complete set of all materials developed to that date be provided for review.

On November 4, Dr. Averch forwarded a similar letter (Exhibit B-8) to the project directors of three additional technically completed projects that had not yet negotiated contracts for commercial publication.

7. Request Additional Information from Project Directors

On November 11, letters (Exhibit B-9) were mailed to directors of each of the nineteen curriculum projects requesting that staff members provide answers to nine of the ten questions on the revised instrument. (The tenth item, "general impressions," was for individual panelist response.) The principal investigator and his staff were requested to provide structured input for the panelists prior to undertaking their assignments.

In addition, the principal investigator was requested to be available during the week of December 8-12 to answer calls should panelists need additional information to respond to the questions.

Principal investigators were also requested to provide enough representative copies of developed materials for panelist review prior to the Washington meeting. Representative materials and information on the projects were scheduled to be mailed to panelists on November 26. The principal investigator was requested to return these materials to AD/SE before that date.

8. Design Format to Ensure Adequate Review

Because panelists were chosen to represent a broad spectrum of private and professional interests and responsibilities, it was important that they be given the opportunity to reflect on the ten questions to ensure maximum input for decision making within AD/SE. However, it was foreseen that the preparation of coherent written reports reflecting this wide range of opinions would be an extremely difficult task.

To facilitate the development of a format that would permit input from all panelists and yet provide useful information for AD/SE, a mixed-block design was used to assign responsibilities to individual panelists for specific questions. Individual panel subgroups (usually 2-3 members) were responsible for writing panel reports on specific questions; these reports would be drafted after panel discussion of each question, shared with other panelists, and rewritten as necessary. The end product of the review would be written responses from each panel reflecting panel opinions and answers to nine of the ten questions (omitting for the time being the general impressions question, the answer to which would be prepared by each panelist). In addition, panelists who did not agree with other panelists' responses to specific questions would be free to prepare and submit "minority reports."

The mixed block design for each panel is shown in Exhibit B-10.

9. Forward Pre-Panel-Meeting Information to Panelists

Letters and accompanying materials were mailed to panelists on November 26, 1975. (Exhibit B-11) Included were verification of the agreement (verbal commitments had earlier been made on the telephone) and logistical information (housing, travel and honoraria), a copy of the ten question instrument and a prepared "evidence package" for each project.

The evidence package included:

a. A summary of the project to be reviewed as originally designed and funded. This summary was prepared by AD/SE staff from materials in AD/SE files and other written documentation.

b. Project Director's responses to nine of the 10 questions.

c. Two or three representative materials from the project. Because of the bulk of materials and the lack of enough copies of specific items for some projects, all available materials were distributed randomly among panelists for review prior to the Washington meeting.

Panelists were informed that complete sets of materials would be available for review in Washington. It was expected that panelists would spend the equivalent of two days preparing for the meeting by reviewing the materials received.

On December 1, a similar letter was forwarded to student panelists with the major difference that students were offered a $25 per day honorarium rather than $75 per day.

PANEL MEETINGS

Prior to the panel meetings, notice was made in the Federal Register of November 21, 1975 (Exhibit B-12).

The panel meetings were subject to the terms of the Federal Advisory Committee Act. As such, the meetings were open to the public; attending members of the public who wished to make verbal statements or provide written documentation to the panelists were free to do so.

The panels were chaired or "facilitated" by a Designated Federal Official--staff members of the National Science Foundation who represented offices which are charged with program planning and review. No panel facilitator had as his normal assignment monitoring of grants for the development or dissemination of curricula. The panel facilitators for the review were:

Panel 1. Dr. Lyle W. Phillips, Special Assistant to the Acting Assistant Director for Science Education

Panel 2. Dr. Richard W. West, Program Manager, Division of Science Education Development and Research

Panel 3. Dr. Vaughn Blankenship, Head, Planning and Policy Analysis, Office of Planning and Resources Management

Panel 4. Dr. Roosevelt Calbert, Program Manager, Office of Program Integration

Panel 5. Dr. Howard L. Jones, Program Manager, Office of Program Integration

Panel 6. Mr. Howard P. Levine, Program Manager, Office of Program Integration

Panel 7. Dr. Alphonse Buccino, Program Manager, Office of Program Integration

The role of the panel facilitator was to ensure panel continuity and progress toward the completion of the effort - the technical evaluation of each of the assigned projects. The facilitator was not prepared nor expected to provide substantive information about the curriculum projects but was to secure for panelists the necessary information and materials needed to complete their evaluation.

At 9:00 A.M. on December 8, Dr. Harvey Averch convened the panelists and described the history of curriculum development activities within NSF and the function of the curriculum review. He also:

a. Described the past and present roles of the Foundation with respect to curriculum development activities;

b. Provided a brief history of events that led to the review;

c. Told panelists that they would be providing a technical evaluation of the nineteen projects with the Foundation generally and the Directorate for Science Education specifically as the audiences;

d. Briefly described how they, as panelists, were chosen;

e. Informed panelists that the meetings would be open to the public and held under the terms of the Federal Advisory Committee Act;

f. Described the role of the panel facilitator as the official governmental representative designated for each panel responsible for

   (1) ensuring that all procedural matters were handled, and

   (2) recognizing and ensuring the input of members of the public who might attend the meeting

A. 9:45 A.M. individual panels met in their assigned rooms. Panel facilitators, after introductions, reviewed with panelists their charge - the development of written reports on each of the assigned projects based on the ten questions provided. The facilitator also reviewed the mixed-block design for the development of group reports. Individual panelists were assigned the questions ~~that~~ they would address in preparation of reports representative of panel opinions and findings. Complete sets of curriculum materials were provided. In addition, Dr. Averch released a memo through the panel facilitators describing other materials that would be made available to any panelist (Exhibit B-13).

Individual schedules and protocol were developed by each panel. The only requirement common to all group panel meetings was that the panel facilitator (the Federally Designated Officer) be present to convene and adjourn the ~~meetings~~ and to provide opportunity for input from any visiting members of the public.

While there were variations in panel protocol, the general format of the panels ~~included~~ the following:

a. Panel review of the materials they deemed necessary for an adequate review. In most cases this step involved one or two days of reading (or viewing films in the case of two projects).

b. Meeting with other members of the panel and discussing each of the ten questions. During this time, those panelists assigned to specific questions, kept careful notes and prepared outlines for their written drafts.

c. After discussion, drafts were completed by the panel sub-groups.

d. Redraft of reports. The drafted responses to the ten questions were read by other panel members and, through group discussion or individual input, additional data were provided so that sub-groups might re-draft their efforts.

e. Additional data gathering techniques used by several panels.

   1) Program managers within the Foundation (those persons responsible for the internal monitoring of the projects) provided information and clarification for panelists upon request.

   2) In one case (the Biomedical Interdisciplinary Curriculum Project), the project director was in Directorate for Science Education offices on December 11 and met with Panels 4 and 5.

   3) In 9 cases, panelists communicated via conference calls with project developers. The following project directors or staff members were contacted by individual panels:

      Panel 1 - Madison Project, Project for the Mathematical Development of Children

      Panel 2 - Mathematical Resource Project

      Panel 3 - Exploring Human Nature

      Panel 4 - ISIS, Technology-People-Environment

      Panel 5 - Human Sciences Program

      Panel 6 - ISIS

      Panel 7 - ISIS

f. A similar cycle of writing and re-writing concluded with a semi-final draft of each report by December 12, except for Panel 3, which concluded its work on January 24, 1976.

All panels concluded their meetings by Friday, December 12. One (Panel 3) did not complete a final draft on one of its projects and decided to complete final input by mail. The panel facilitator then convened a smaller sub-group on January 24, 1976 to prepare the final report based on the mailed responses to the questions.

In most cases, panelists were forwarded copies of the semi-final drafts for final edit. In those cases where minor corrections were made by panelists the corrections were made by the panel facilitators. In those cases where large-scale changes were requested, the panel facilitators contacted panelists by phone to get agreed-upon wording. Panelists were also requested to ensure that their answers to the tenth "General Impressions" question were forwarded for each of the curriculum projects.

Finally, the completed and finally typed panel reports and individual responses were forwarded to all panelists for final certification and approval.

EXHIBITS

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

nsf

OFFICE OF THE
ASSISTANT DIRECTOR
FOR SCIENCE EDUCATION

November 10, 1975

Mr. Albert Shanker
American Federation of Teachers
1012 14th Street, N.W.
Washington, D.C. 20005

Dear Mr. Shanker:

The Directorate for Science Education of the National Science Foundation is undertaking a review and evaluation of 19 pre-college curriculum development projects which it hopes to complete by January 31, 1976.

The purposes of the evaluation are stated in my letters of October 23 and November 4 to our curriculum project leaders. I have enclosed a copy of these letters as well as a list of the projects to be evaluated. As part of this evaluation, we plan to assemble several advisory panels for the week of December 8-12, 1975 to examine and judge evidence concerning these projects. We are asking a number of relevant organizations to assist us in finding informed panelists. To insure an objective and informed review, I would appreciate your nominating 6-10 individuals from your membership whom you believe would be highly qualified to serve on the panels.

The selected panelists will be asked to assess the scientific accuracy and merit, the educational value, the suitability, need and general merit of the instructional materials, and the effectiveness of management procedures. Panels will convene in Washington, D.C. December 8-12, 1975. Each panel will be asked to review three to six projects.

Prior to the Washington meeting, panelists will receive descriptive information concerning curricula they will be asked to judge. At the Washington meetings the panels will synthesize individual and collective points of view concerning the instructional materials. The end product will be written individual and panel reports to the Foundation evaluating the projects on a number of important dimensions. We would also like the panels to provide recommendations that the Foundation can use in determining future development and dissemination plans.

The importance of this evaluation for American science education cannot be overstated. It will be an important determinant of Foundation priorities for the next several years. Since the time is short, I ask that you get your nominees to us by November 15, 1975. We would welcome receiving your nominations over the phone. It would be helpful if you could provide information on the background and experience of each individual. Please call Dr. Al Buccino collect with your nominations at 202/282-7947.

If possible, I would appreciate your listing the nominees in the order you would recommend them to NSF. If you have substantive questions, please feel free to call Dr. Buccino. He or one of the members of our curriculum review task force will be happy to respond to questions.

Once we receive the nominations from each of the organizations we are contacting, we will make panel selections to obtain the variety of perspectives necessary for a broad and rigorous evaluation. Our staff will then contact the selected nominees directly.

Approximately 75 panelists will be needed for the evaluation. Those selected as panelists will receive an honorarium of $75.00 per day for their work as well as support for travel and per diem while they are in Washington.

Although we may not be able to select representatives from every relevant organization, we greatly appreciate your assistance in the selection process. We will send you the results of our evaluation when it is completed.

Sincerely yours,

Harvey Averch

Harvey Averch
Acting Assistant Director
for Science Education

Enclosure

cc: Dr. Stever, Director, NSF
Dr. Hackerman, Chairman, NSB

Exhibit B-1 (cont.)

ORGANIZATIONS INITIALLY CONTACTED FOR PANEL NOMINEES

a. SCIENTIST/MATHEMATICIANS

Dr. Robert W. Cairns
Executive Director
American Chemical Society
1155 16th Street, N.W.
Washington, D.C. 20036

Dr. Philip Handler
President
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Dr. W. W. Havens, Jr.
Executive Secretary
American Physical Society
335 E. 45th Street
New York, New York 10017

Dr. H. J. Lewis
Director
Office of Information
National Academy of Engineering
2101 Constitution Ave., N.W.
Washington, D.C. 20418

Dr. Hans O. Mauksch
Executive Officer
American Sociological Association
1722 N Street, N.W.
Washington, D.C. 20036

Mr. Mike A. Riley
Director
American Medical Association
1776 K Street, N.W.
Washington, D.C. 20006

Dr. Mack Thompson
Executive Director
American Historical Association
400 A Street, S.E.
Washington, D.C. 20003

Dr. Richard Trumbull
Executive Director
American Institute of Biological Sciences
1401 Wilson Boulevard
Arlington, Virginia 22209

Mr. Dennis W. Weissman
Director
American Society for Medical Technology
1725 De Sales Street, N.W.
Washington, D.C. 20036

Dr. A. B. Willcox
Mathematical Association of America
1225 Connecticut Avenue, N.W.
Washington, D.C. 20036

b. PROFESSIONAL EDUCATORS

(1) Elementary/Secondary Teachers

Dr. James Gates
National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 22070

Dr. Jerry P. Lightner
Executive Director
National Assn. of Biology Teachers
1420 N Street, N.W.
Washington, D.C. 20005

Mr. John Ryor
President
National Education Association
1201 16th Street, N.W.
Washington, D.C. 10026

Mr. Albert Shanker
American Federation of Teachers
1012 14th Street, N.W.
Washington, D.C. 20005

Exhibit B-2

Dr. Melba Phillips
Acting Executive Officer
American Association of Physics Teachers
Drawer AW
Stony Brook, New York 11790

Dr. Robert Silber
Executive Secretary
National Science Teachers Association
1742 Connecticut Avenue, N.W.
Washington, D.C. 20009

(2) School Administrators

Dr. Byron W. Hansford
Council of Chief State School Officers
1201 16th Street, N.W.
Washington, D.C. 20036

Dr. Owen Kiernan
Executive Director
National Association of Secondary School Principals
1904 Association Drive
Reston, Virginia 22091

Dr. William Pharis
Executive Director
National Association of Elementary School Principals
Executive and Editorial Offices
1801 N. Moore Street
Arlington, Virginia 22209

Dr. Paul B. Salmon
Executive Director
American Association of School Administrators
1801 North Moore Street
Arlington, Virginia 22209

(3) Science/Mathematics Supervisors

Mr. Gordon Cawelti
Executive Director
Association for Supervision and Curriculum Development
1201 16th Street, N.W.
Washington, D.C. 20036

Note: In addition to this one source, it was also anticipated that supervisors would be recommended by the National Science Teachers Association and the National Council for Teachers of Mathematics.

(4) Science/Mathematics Educators in College Settings

Dr. John A. D. Cooper
President
Association of American Medical Colleges
One DuPont Circle, N.W.
Washington, D.C. 20036

Dr. Eileen Jacobi
Executive Director
American Nurses Association
2420 Pershing Road
Kansas City, Missouri 64108

Dr. Donald E. Marlowe
Executive Director
American Society for Engineering Education
One DuPont Circle, N.W.
Washington, D.C. 20036

Note: These sources were considered especially fruitful in the identification of panelists for review of the Biomedical Interdisciplinary Curriculum Project as well as Technology, People, Environment.

Dr. Eleanor Sheldon
Social Science Research Council
1755 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Dr. Patrick Suppes
President
National Academy of Education
Stanford University
Stanford, California 94305

In addition to these sources, it was also anticipated that a number of other, earlier mentioned groups would recommend college based science and mathematics educators.

c. CHILD/ADOLESCENT DEVELOPMENT SPECIALISTS

Ms. M. Block
Administrative Secretary
American Group Psychotherapy Association
1865 Broadway, 12th Floor
New York, New York 10023

Dr. Marlon F. Langer
Executive Director
American Orthopsychiatric Association, Inc.
1790 Broadway
New York, New York 10019

Dr. Mark H. Lewin
Executive Director
American Board of Examiners of Professional Psychology
185 Broad Street, East
Rochester, New York 14604

Dr. William J. Russell
Executive Officer
American Educational Research Association
1126 16th Street, N.W.
Washington, D.C. 20036

Dr. Melvin Sabshin
Medical Director
American Psychiatric Association
1700 18th Street, N.W.
Washington, D.C. 20009

Exhibit B-2 (cont.)

d. COMMERCIAL PUBLISHING REPRESENTATIVE

Mr. Thomas McKee
Vice President
Association of American Publishers
1 Park Avenue
New York, New York 10016

e. INFORMED PUBLIC COMMUNITIES

1. Parents and other interested lay citizens

Mr. Alden G. Barber, Director
Boy Scouts of America
U.S. Highway #1
North Brunswick, New Jersey 08902

Mr. Seymour S. Berlin
Executive Director
American Society for Public Administration
1225 Connecticut Avenue, N.W.
Washington, D.C. 20036

Dr. Ronald Berman, Chairman
National Endowment for the Humanities
806 15th Street, N.W.
Washington, D.C. 20506

Ms. Mary M. Burch
Regional Director
Girl Scouts of America
1911 North Fort Myer Drive
Rosslyn, Virginia 22209

Mr. David Cohen
President, Common Cause
2030 M Street, N.W.
Washington, D.C. 20036

Ms. Joan Ganz Cooney
President
Children's Television Workshop
1 Lincoln Plaza
New York, New York 10023

Mr. Robert M. Crum
Managing Director
National Congress of Parents and Teachers
700 North Rush Street
Chicago, Illinois 60611

Mr. Walter Davis
Director, Department of Education
American Federation of Labor--Congress of Industrial Organizations
815 16th Street, N.W.
Washington, D.C. 20006

Ms. Karen De Crow
Executive Director
National Organization for Women
National Office
5 South Wabash Avenue
Chicago, Illinois 60603

Ms. Nancy Hanks, Chairman
National Endowment for the Arts
806 15th Street, N.W.
Washington, D.C. 20506

Mr. William F. Hauck
National Adjutant
The American Legion National Organization
1608 K Street, N.W.
Washington, D.C. 20006

Exhibit B-2 (cont.)

Mr. Herbert E. Hoffman
Director
American Bar Association
1705 De Sales Street, N.W.
Washington, D.C. 20036

Dr. Richard Lesher
President
Chamber of Commerce of U.S.A.
1615 H Street, N.W.
Washington, D.C. 20006

Mr. Carl L. Marburger
Senior Associate
National Committee for Citizens in Education
Suite 410, Wild Lake Village Green
Columbia, Maryland 21044

Mr. Clarence Mitchell, Director
National Association for the Advancement of Colored People
Washington Bureau
733 - 15th Street, N.W., Suite 410
Washington, D.C. 20002

Mr. Grant Shrum
Executive Director
4-H National Foundation
7100 Connecticut Avenue
Chevy Chase, Maryland 20015

Mrs. Wakelee R. Smith
President General
Daughters of the American Revolution
1776 D Street, N.W.
Washington, D.C. 20006

2. School Board Members

Mr. Robert McBride
President
National Association of State Boards of Education
1500 Spring Lane
Wilmington, Delaware 19809

Dr. Harold V. Webb
Executive Director
National School Boards Association
P.O. Box 1496
Evanston, Illinois 60204

f. OTHER SOURCES

Two other major sources were tapped because of their broadly based representation and prese ..influence on American education. It was anticipated that these sources would provide possible panelists that would fit into a number of the already-mentioned categories. These sources are:

Dr. Roy H. Forbes
Director
National Association of Educational Progress
700 Lincoln Tower
1860 Lincoln Street
Denver, Colorado 80203

Dr. Kenneth P. Komoski
Executive Director
Educational Products Information Exchange Institute
463 West Street
New York, New York 10014

Exhibit B-2 (cont.)

PANELIST SOURCES BY ORGANIZATION

Organization	Panel Numbers
American Association of Physics Teachers	5
American Board of Professional Psychology	1
American Educational Research Association	2
American Group Psychotherapy Association	4
American Historial Association	3
American Institute for the Biological Sciences	4, 5, 5, 6, 6
American Legion	6
American Orthopsychiatric Association	3
American Physical Soceity	4, 6
American Psychiatric Association	5, 6
American Psychotherapy Association	5
American Society for Engineering Education	4
American Society for Medical Technology	4
American Sociological Association	3
Assocation for the Education of Teachers of Science	1, 4
Assocation of American Medical Publishers	7, 7, 7, 7
Common Cause	2
Council of State Supervisors of Social Studies	3, 6
Daughters of American Revolution	4
Educational Products Information Exchange	6
Local School Administration	3, 4, 4, 5, 6
Mathematical Association of America	1, 2, 2
National Assessment of Educational Progress	4
National Association of Biology Teachers	6
National Association of Elementary Principals	1
National Association of Secondary School Principals	2, 3, 4, 5, 6
National Association of State School Boards	5
National Committee for Citizens in Education	1, 3
National Congress of Parents and Teachers	2, 3
National Council for Educational Excellence	3
National Council for the Social Studies	3, 3
National Council for Teachers of Mathematics	1, 1, 1, 1, 1, 2, 2, 2, 2
4-H National Foundation	5
National Science Teachers Association	4, 4, 5, 5, 5, 5, 6, 6
Social Science Research Council	3

Total = 74*

* One panelist did not attend due to illness.

Exhibit B-3

Geographic Distribution of Panelists

NORTHEAST - 19

Massachusetss - 3
New Hampshire - 1
New Jersey - 5
New York* - 7
Pennsylvania -
Vermont - 2

MID EAST - 12

District of Columbia - 6
Maryland - 2**
Virginia - 2
West Virginia - 2

SOUTHEAST - 7

Alabama - 1
Florida - 1
Georgia - 2
Mississippi - 1
North Carolina - 1
Tennessee - 1

NORTH CENTRAL - 16

Illinois - 3
Indiana - 1
Michigan - 3
Minnesota - 6
Ohio - 3

CENTRAL AND SOUTH CENTRAL - 10

Iowa - 1
Kansas - 3
Missouri - 1
South Dakota - 1
Texas - 4

WESTERN - 10

Arizona - 1
California - 5
Colorado - 2
Nevada - 1
Utah - 1

Total = 74**

* One New Yorker is on leave to a professional society from Kansas State University. The Society is based in New York.
** One panelist who was chosen became ill and did not attend.

Exhibit B-4

NATIONAL SCIENCE FOUNDATION

WASHINGTON D.C. 20550

nsf

TO: Panel Members

FROM: Acting Assistant Director for Science Education

SUBJ: Pre-College Curriculum Review

The Science Education Directorate of the National Science Foundation is currently conducting a systematic review and evaluation of 19 pre-college curriculum development projects. We will be convening panels of 6-10 members in Washington during the week of December 8-12, 1975. Each panel will be composed of members of the scientific, education, publishing, and learning theorist communities as well as the lay public.

The review will be based on the objectives stated in the original proposal, the progress achieved to date, and the products thus far available. We expect the panels to use this evidence in evaluating each project's scientific merit, educational value, need to education, implementation plan, and the effectiveness of management and financial plans.

This evaluation will play a central role in determining the future policy of the National Science Foundation towards curriculum development. I envision that the final report of each panel will contain recommendations which will help me in the process of decision making.

Harvey Averch

Exhibit B-5

1. IS THERE A GENUINE NEED FOR THESE INSTRUCTIONAL MATERIALS?

Please consider the evidence package and other information you may possess in answering the following questions:

A. What are the project's efforts at needs assessment?

B. Are there any other documented and/or generally accepted needs for these instructional materials?

C. How many pupils could these materials be expected to reach?

D. Are there any satisfactory alternative instructional materials in this area?

F. Please note additional questions and/or evidence you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, HOW GREAT IS THE NEED FOR THESE INSTRUCTIONAL MATERIALS? HOW SOCIALLY SIGNIFICANT IS THE NEED? HOW SATISFACTORY IS THE NEEDS ASSESSMENT? Please refer to the above questions in developing your answer.

2. IS THERE A MARKET FOR THESE INSTRUCTIONAL MATERIALS?

Please consider the evidence package and other information which you may possess in answering the following questions.

A. What other products are available to meet the need?

B. Is there room for this product in the curriculum; that is, is there a pre-existing slot for these instructional materials in a significant number of school curricula plans, or will the adoption of these materials require a reconceptualization of curricula plans?

C. How effective is the project's dissemination plan? Will reliance need to be placed on NSF for implementation monies?

D. What has been the free market (i.e., unsubsidized) response to the need that these instructional materials are assigned to fill?

E. What is the likelihood that the product would be used if available (market studies, publisher commitments)?

F. Please note additional questions and/or evidence you think important in answering this question

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, HOW LARGE AND SIGNIFICANT IS THE MARKET FOR THESE INSTRUCTIONAL MATERIALS? WHAT WOULD THE IMPACT OF THESE NEW INSTRUCTIONAL MATERIALS BE ON THOSE ALREADY IN THE MARKET PLACE? Please refer to the above questions in developing your answer.

591

Exhibit B-5 (cont.)

3. DO THESE INSTRUCTIONAL MATERIALS POSSESS A CLEAR PURPOSE AND RATIONALE?

Please consider the evidence package and other information which you may possess in answering the following questions:

A. What are the stated assumptions, values, and goals behind these instructional materials?

B. What assumptions, values, and goals may be inferred directly from the instructional materials themselves?

C. Is it reasonable to expect that instructional materials based on these assumptions, values, and goals will fill the need documented in question 1? Are there alternative assumptions, values, and goals that could generate materials to meet that need?

D. Are the instructional materials themselves clear and understandable? Do they form a cohesive package? Is the sequence of presentation clear?

E. What is the rationale for the selection of individual curriculum modules (if there are such)? Is it plausible?

F. Please note additional questions and/or evidence you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, HOW CLEAR AND PERSUASIVE IS THE PURPOSE AND RATIONALE OF THESE INSTRUCTIONAL MATERIALS? HOW WELL DO THE IMPLICIT AND EXPLICIT ASSUMPTIONS, VALUES, AND GOALS MATCH THE INSTRUCTIONAL MATERIALS? Please refer to the above questions in developing your answer

592

4. IS THE CONTENT OF THESE INSTRUCTIONAL MATERIALS SCIENTIFICALLY CORRECT?

Please consider the evidence package and other information which you may possess in answering the following questions:

A. To what degree are the instructional materials scientifically accurate?

B. To what degree are the instructional materials scientifically current?

C. Is the content of these instructional materials aimed towards training future scientists or aimed toward a scientifically literate population?

D. What portion of the discipline, and approach to the discipline, is represented by these instructional materials?

E. Please note additional questions and/or evidence you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, TO WHAT DEGREE ARE THESE INSTRUCTIONAL MATERIALS SCIENTIFICALLY CORRECT? Please refer to the above questions in developing your answer.

5. IS THE CONTENT OF THESE INSTRUCTIONAL MATERIALS EDUCATIONALLY SOUND?

Please consider the evidence package and other information which you may possess in answering the following questions:

A. Do you anticipate any adverse reactions to these instructional materials from teachers, staff, parents, or pupils? Are there any especially favorable reactions which may also be anticipated?

B. Does the content/approach present any special cognitive, affective, or psycho-motor difficulties for the students at the age and development level targeted? Does the content/approach demonstrate ingenuity or possess special promise in its tailoring to learning styles and types?

C. Are there any students for whom this content/approach should not be used? Any for whom it would be particularly effective?

D. What are the instructional materials' strategies for dealing with value-laden areas? Are they adequate? Are they particularly impressive or ingenious?

E. Please note additional questions and/or evidence you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, TO WHAT DEGREE IS THE CONTENT OF THESE INSTRUCTIONAL MATERIALS EDUCATIONALLY SOUND? (Please refer to the above questions in developing your answer.

6. ARE THE PROPOSED AND ANTICIPATED OUTCOMES OF THE INSTRUCTIONAL MATERIALS DESIRABLE?

Please consider the evidence package and other information which you may possess in answering the following questions:

A. What are the anticipated impacts of these instructional materials on all consumers: students, teachers, school districts, etc.?

B. Which of the intended effects would you expect to be realized as a result of using these materials?

C. What unintended effects might you anticipate as a result of using these materials?

D. Is the content and approach of these materials fair; are they free of sex, racial, ethnic, and religious bias or stereotyping?

E. What are the important process features (i.e., outcomes not derived from the content of the instructional materials but from other features such as method of instruction) of these instructional materials?

F. Please note additional questions and/or evidence you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, TO WHAT DEGREE ARE THE PROPOSED AND ANTICIPATED OUTCOMES OF THESE INSTRUCTIONAL MATERIALS DESIRABLE? Please refer to the above questions in developing your answer.

Exhibit B-5 (cont.)

7. DO THESE INSTRUCTIONAL MATERIALS PRESENT IMPLEMENTATION PROBLEMS FOR THE SCHOOLS?

Please consider the evidence package and other information which you may possess in answering the following questions:

A. Is special training needed by teachers to use these instructional materials effectively? What type of training?

B. Do these materials pose any special problems for existing organizational structure within the schools?

C. Are the costs of these new instructional materials realistic?

D. Do the new instructional materials require any special learning resources?

E. Will the new instructional materials require school districts to establish optional classes for those who do not wish to use the new materials; e.g., are the materials value-laden, designed for bright students, etc.?

F. Please note additional questions and/or evidence you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, WHAT BARRIERS TO IMPLEMENTATION ARE PRESENTED BY THESE INSTRUCTIONAL MATERIALS? HOW GREAT ARE THESE BARRIERS? HOW MUCH HELP WOULD SCHOOL DISTRICTS NEED TO IMPLEMENT THESE INSTRUCTIONAL MATERIALS? Please refer to the above questions in developing your answer.

8. ARE THE COSTS FOR IMPLEMENTING THESE INSTRUCTIONAL MATERIALS REASONABLE?

Please consider the evidence package and other information which you may possess in answering the following questions:

A. What are the expected total dollar costs for implementing these instructional materials (e.g., materials for learners, teachers, staff, training personnel, installation, etc.)?

B. What are the costs of continuing use of the instructional materials; are there "refill" needs, support service costs?

C. What other ways might the school district spend money to meet the same need?

D. What are the expected costs of comparable instructional materials?

E. What non-fiscal costs might be involved, e.g., psychological/social?

F. Please note additional questions and/or evidence you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, TO WHAT DEGREE ARE THE COSTS OF IMPLEMENTING THESE MATERIALS REASONABLE? Please refer to the above questions in developing your answer.

Exhibit B-5 (cont.)

9. IS THE MANAGEMENT/ORGANIZATION PLAN ADEQUATE FOR PRODUCING THESE INSTRUCTIONAL MATERIALS?

Please consider the evidence package and other information which you may possess in answering the following questions:

A. Has there been adequate opportunity for all interested parties (scientists, educators, lay people) to provide input into development of these materials?

B. Are there adequate internal monitoring procedures for the project?

C. Are there adequate external (independent) evaluation procedures for the project?

D. Does the project seem to be top heavy administratively? Does the project seem to be too thinly administered?

E. Is the project staff providing adequate information to NSF and other interested parties?

F. Please note additional questions and/or eviden e you think important in answering this question.

IN YOUR JUDGMENT AND BASED ON THE EVIDENCE, HOW ADEQUATE ARE THE MANAGEMENT/ORGANIZATION PLANS OF THIS PROJECT? Please refer to the above questions in developing your answer.

10. WHAT ARE YOUR GENERAL IMPRESSIONS OF THE CURRICULUM? WHAT ARE YOUR PERSONAL FEELINGS ABOUT THE VALUES, CONTENT, APPROACH AND POSSIBLE USE OF THESE INSTRUCTIONAL MATERIALS? WOULD YOU MAKE ANY RECOMMENDATIONS TO THE PROJECT STAFF; FOR EXAMPLE, INSTRUCTIONAL MATERIAL REVISION, DISSEMINATION OR MANAGEMENT PLAN?

Exhibit B-5 (cont.)

NATIONAL SCIENCE FOUNDATION

WASHINGTON, D.C. 20550

MEMORANDUM

December 5, 1975

MEMBERS OF THE PANEL COMPOSED OF PUBLISHERS' REPRESENTATIVES ARE ASKED TO ADDRESS THE FOLLOWING QUESTIONS:

1. What impact has the funding practices of NSF's pre-college implementation program had on the supported educational materials and their publishers?

2. What has Federal funding (and, specifically, NSF funding) for curriculum development added to education that might not normally have occurred in the commercial sector? Does Federal funding inhibit the growth of the commercial sector?

3. Are there better ways for NSF to support curriculum development by working more closely and directly with publishers?

4. What is the economic status of the industry? Can they now support curriculum R&D projects of reasonable sizes?

5. If not, what are the barriers to more R&D in the private sector?

Exhibit B-6

606

October 23, 1975

Ref: PES75-02213

Dr. Richard V. Andree
Physical Science Center
University of Oklahoma
Norman, Oklahoma 73069

Dear Dr. Andree:

As you know, the National Science Foundation has recently been reorganized. The Science Education Directorate of the National Science Foundation is reorganized effective October 31. As a necessary correlate of the reorganization, we are examining and reassessing priorities for science education. As a part of this examination I have directed our staff and associated consultant reviewers to carry out a systematic review and evaluation of our sixteen active pre-college curriculum development projects. I have specified that the review cover the scientific merit, the educational value, and the effectiveness of management and financial procedures.

Our review will be based on the objectives stated in the original proposal, the progress achieved to date, and the products thus far available. Our intent is to carry out the review with the best information currently available from your project, and not have you create or submit any new material. In some cases your NSF program manager may not have all current materials. I would appreciate your sending all materials not in our possession as soon as possible, whatever their current state of development.

This review is also responsive to the Congressional directive from the House Appropriations Committee (House Report 94-313) in reference to our 1976 budget. This directive states that we must develop a clear statement of national needs and a clear rationale for those curriculum projects we wish to carry to the implementation phase. Our review is intended to help us develop the required statements of need and the associated rationales. In addition, the House Science and Technology Committee, which authorizes the Foundation's programs, is engaged in a review of the Foundation's overall pre college curriculum implementation policy (see House Report 94 44). Thus, we need systematic information on the status of all our projects.

Exhibit B-7

The National Science Board (NSB), our chief policy-making body, also directed in June 1975 that "prior to undertaking full-scale dissemination and assistance activities for NSF-developed materials, NSF should undertake a careful review to ensure that the proposed subject matter fits within reasonable limits or norm with respect to educational values and that the scientific content is accurate."

I have instructed our staff to carry out the review of all projects in a timely and effective manner. The review will be carried out by several panels of scientists, educators, and informed representatives of the public. We expect to complete this review in the next two months and will inform you as soon as possible about its outcome.

To permit our Directorate time to schedule its activities in response to the NSB mandate, as well as to carry out our review in a rigorous and systematic manner, I am requesting that you evaluate the impact of this review on your publication plans and schedules and inform us as soon as possible. It will be necessary that the review be completed before any additional publication or printing of materials is undertaken. Therefore, I am requesting you advise us of the actions you will take to assist us in implementing the review. I am also requesting that you make contingency plans for incorporating the results of the review in your project and inform us of these.

Sincerely,

Harvey Averch
Acting Assistant Director
for Science Education

cc: Dr. Stever
Dr. Atkinson
Dr. Hackerman

Exhibit B-7 (cont.)

PROJECT	PROJECT DIRECTOR	ADDRESS OF PROJECT DIRECTOR
Technology-People-Environment	John G. Truxal (Dr.) E. J. Piel PES73-06350	Dean of Engineering[9] SUNY - Stony Brook Stony Brook, New York 11790
Probelm Solving Strategies and Applications of Mathematics in the Elementary School	George Springer (Dr.) John LeBlanc (GW-7911)PES74-15045	Dept. of Mathematics and Mathematics Education Development Center Indiana University Bloomington, Indiana 47401
Project for the Mathematical Development of Children	Eugene D. Nichols (Dr.) T. Denmark (GW-7913)PES74-18106	Mathematics Education Program Florida State University Tallahassee, Florida 32304
Development of a Mathematics Program for Grades 7 and 8	Uri Haber-Schaim (Dr.) (GW-7912)PES-7418105	Physical Science Group Boston University 38 Cummington Street Boston, Massachusetts 02215
Mathematics Resource Project: Topical Resources for Middle School Mathematics Teachers	Alan Hoffer (Dr.) T. L. Nelson (GW-7910)PES74-15047	Department of Mathematics University of Oregon Eugene, Oregon 97403
First-Year Algebra via Applications Development Project	Zalman P. Usiskin (Prof.) (GW-7915)PES74-18948	Graduate School of Education University of Chicago Chicago, Illinois 60637
Creation, Testing, and Dissemination of Problem Solving Instructional Material	Richard V. Andree (Dr.) PES75-02213	Physical Science Center University of Oklahoma Norman, Oklahoma 73069

Exhibit B-7 (cont.)

PROJECT	PROJECT DIRECTOR	ADDRESS OF PROJECT DIRECTOR
Exploring Human Nature	Peter Dow (Mr.) (GW-5209)PES69-01072	EDC Social Studies Program 15 Mifflin Place Cambridge, Massachusetts 02138
Unified Science and Mathematics for Elementary Schools (Grantee: Education Development Center)	Earle L. Lomon (Dr.) (GW-5207)PES69-01071	Department of Physics Massachusetts Inst. of Tech. Cambridge, Massachusetts 02139
Human Sciences Program	Norris Ross (Mr.) (GW-7644)PES72-06305	Biological Sciences Curriculum Study Co. P. O. Box 930 Boulder, Colorado 80302
The Biomedical Interdisciplinary Curriculum Project	Dr. Leonard A. Hughes (GW-6815)PES72-05819	California Committee on Regional Medical Problems 15 Webster Street Oakland, California 94612
Outdoor Biology Instructional Strategies	Watson M. Laetsch (Dr.) (GW-6820)PES72-05823	Director, Lawrence Hall of Science University of California Berkeley, California 94720
Source Book on Applied Mathematics (Grantee: Committee on the Undergraduate Program in Mathematics)	Alex Rosenberg (Dr.) (GW-7904)PES 72-01123	Cornell University Ithaca, New York 14850
Individualized Science Instructional System	Ernest Burkman (Dr.) (GW-7545)PES72-06306	Director, Educational Research Institute Florida State University Tallahassee, Florida 32306
High School Political Science Curriculum (Comparing Political Experiences)	Howard D. Mehlinger (Dr.) (GW-6810)PES72-05814	Social Studies Development Center Indiana University Bloomington, Indiana 47401
Human Behavior Curriculum Project (Grantee: American Psychological Assn.)	John Bare (Dr.) (GW-7905)PES73-05337	Carleton College Northfield, Minnesota 55057

November 4, 1975

Ref: PES64-00029

Mr. Jack Churchill
Education Development Center
55 Chapel Street
Newton, Massachusetts 02160

Dear Mr. Churchill:

As you know, the National Science Foundation has recently been reorganized. The Science Education Directorate of the National Science Foundation is reorganized effective October 31. As a necessary correlate of the reorganization, we are examining and reassessing priorities for science education. As a part of this examination I have directed our staff and associated consultant reviewers to carry out a systematic review and evaluation of our sixteen active pre-college curriculum development projects. I have also directed the staff to extend the review to three projects no longer technically active, but whose materials are relevant to our general reassessment. Your project is one of those. I have specified that the review cover the scientific merit, the educational value, and the effectiveness of management and financial procedures.

Our review will be based on the objectives stated in the original proposal, the progress achieved to date, and the products thus far available. Our intent is to carry out the review with the best information currently available from your project, and not have you create or submit any new material. In some cases your NSF program manager may not have all current materials. I would appreciate your sending all materials not in our possession as soon as possible, whatever their current state of development.

This review is also responsive to the Congressional directive from the House Appropriations Committee (House Report 94-313) in reference to our 1976 budget. This directive states that we must develop a clear statement of national needs and a clear rationale for those curriculum projects we wish to carry to the implementation phase. Our review is intended to help us develop the required statements of need and the associated rationales. In addition, the House Science and Technology Committee, which authorizes the

Foundation's programs, is engaged in a review of the Foundation's overall pre-college curriculum implementation policy (see House Report 94-44). Thus, we need systematic information on the status of all our projects.

The National Science Board (NSB), our chief policy-making body, also directed in June 1975 that "prior to undertaking full-scale dissemination and assistance activities for NSF-developed materials, NSF should undertake a careful review to ensure that the proposed subject matter fits within reasonable limits or norm with respect to educational values and that the scientific content is accurate."

I have instructed our staff to carry out the review of all projects in a timely and effective manner. The review will be carried out by several panels of scientists, educators, and informed representatives of the public. We expect to complete this review in the next two months and will inform you as soon as possible about its outcome.

To permit our Directorate time to schedule its activities in response to the NSB mandate, as well as to carry out our review in a rigorous and systematic manner, I am requesting that you evaluate the impact of this review on your publication plans and schedules and inform us as soon as possible. It will be necessary that the review be completed before any publication or release of materials is undertaken. Therefore, I am requesting you advise us of the actions you will take to assist us in implementing the review. I am also requesting that you make contingency plans for incorporating the results of the review in your project and inform us of these.

Sincerely,

SIGNED

Harvey Averch
Acting Assistant Director
for Science Education

cc:Dr. Stever
Dr. Atkinson
Dr. Hackerman

(Identical letter sent to attached list of addresses)

PROJECT	PROJECT DIRECTOR	ADDRESS OF THE PROJECT DIRECTOR
The Arithmetic Project*	Dr. David A. Page (Now being managed by Jack Churchill) (GE-7913) PES 64-00029	(Churchill) Education Development Center 55 Chapel Street Newton, Massachusetts 02160
The Madison Project Films*	Dr. Robert B. Davis (G-19148)PES67-00223	Curriculum Laboratory 1210 W. Springfield Urbana, Illinois 61801
Four Motion Pictures in Social Biology*	Dr. Ed Kormondy (GW06713)PES 71-04135	Division of Natural Sciences The Evergreen State College Olympia, Washington 98505

* Slightly modified letter sent since project is no longer technically active but material is ready for distribution

Exhibit B-8 (cont.)

NATIONAL SCIENCE FOUNDATION

WASHINGTON D.C. 20550

nsf

OFFICE OF THE
ASSISTANT DIRECTOR
FOR SCIENCE EDUCATION

November 11, 1975

Dr. Zalman P. Usiskin
University of Chicago
Chicago, Illinois 60637

Dear Dr. Usiskin:

I am writing to keep you informed about the evaluation of all technically active pre-college curriculum development projects which I directed in my letters of October 23 or November 4. We are making steady progress on the logistical and substantive aspects of the evaluation. Our panels will meet in Washington during the week of December 8-12, 1975. Although I do not think it possible to have the panels conduct site visits during these particular evaluations, I hope that you, or a senior member of your staff, will be available that week to answer phone calls from panel members. Depending on the panel's preference and your own schedule, panelists may wish to discuss your project with you in Washington. We do, however, plan future site visits as a regular part of our evaluation system.

I am enclosing the general charge to the panels, the particular sets of curricula each panel will examine, and the questions we will ask. These ten questions are directly relevant to our future decisions in both curriculum development and implementation. Many of our awardees have asked if they could submit material for review. I invite you to submit ordered written material presenting your project's perspective and viewpoint relative to our ten questions. We can use a concise statement of 20 pages or less. Since such statements will be sent to our panelists prior to the meetings, I would like to have 10 copies by November 24.

I would also like individual panelists to be able to review some representative materials from your project prior to coming to Washington. I would appreciate your selecting two or three representative examples of instructional materials and to forward 10 copies to me also by November 24, 1975. If you have not yet done so, I would appreciate your sending one copy of all materials not in our possession designed for current or future trials or for market.

I realize that these requests may place a burden on you and your staff. But I know you will agree with me that current statements and perceptions from project directors, as well as instructional materials, are important evidence for an informed and systematic review and evaluation.

Please call Dr. Alphonse Buccino at 202/282-7947 if you have any questions. He or one of the members of our curriculum review task force will be happy to answer them.

Sincerely yours,

Harvey Averch

Harvey Averch
Acting Assistant Director
for Science Education

Enclosures

cc: Dr. Stever
Dr. Hackerman
Dr. Atkinson

Exhibit B-9 (cont.)

Responsibilities

PANEL RESPONSIBILITIES

PANEL 1

Dr. Shirley Hill	Dr. James Okey	Ms. Dora Skypek	Dr. David Ireland	Mr. Michael P. Klentschy	Mr. William Versnoff	Dr. Marilyn Suydam	Dr. E. Glenadine Gibb	Ms. Betty Murphy	Mrs. Robert Klenn	Mr. Jane Donnelly Gawronski	
	x						x	x			1. Is there a genuine need for these instructional materials?
	x					x					2. Is there a market for these instructional materials?
x			x						x		3. Do these instructional materials possess a clear purpose and rationale?
x		x									4. Is the content of these instructional materials scientifically correct?
	x			x	x			x			5. Is the content of these materials educationally sound?
			x						x		6. Are the proposed and anticipated outcomes of these instructional materials desirable?
	x			x	x					x	7. Do these instructional materials present implementation problems for the schools?
		x								x	8. Are the costs for implementing these instructional materials reasonable?
						x	x				9. Is the management/evaluation plan adequate for producing these instructional materials?
x	x	x	x	x	x	x	x	x	x	x	10. What are your general impressions of the instructional materials?

PANEL RESPONSIBILITIES

PANEL 2

Prof. Donald Kreider	Dr. Jerry A. McIntosh	Ms. Mary Frouster	Mr. ... Clappell	Mr. Daniel P. Moran	Prof. Edward Begle	Prof. John Allen Easley	Mr. Leroy Sachs	Dr. Carmen Cutinone	Mr. Roy Matthews	
	x						x			1. Is there a genuine need for these instructional materials?
	x									2. Is there a market for these instructional materials?
			x			x				3. Do these instructional materials possess a clear purpose and rationale?
x		x			x					4. Is the content of these instructional materials scientifically correct?
							x			5. Is the content of these materials educationally sound?
					x	x		x		6. Are the proposed and anticipated outcomes of these instructional materials desirable?
				x					x	7. Do these instructional materials present implementation problems for the schools?
			x						x	8. Are the costs for implementing these instructional materials reasonable?
x								x		9. Is the management/evaluation plan adequate for producing these instructional materials?
x	x	x	x	x	x	x	x	x	x	10. What are your general impressions of the instructional materials?

Exhibit B-10

PANEL-RESPONSIBILITIES

PANEL 3

Dr George Carey	Dr Michael O'Leary	Dr. Douglas Alder	Mrs Verna Fancett	Mrs James Campbell	Dr John C. Lineman	Mr. David Enestrom	Dr. Robert Angell	Dr. Ethel Tobach	Mrs Juliana Podraza	Mrs Kristina McCough	Mr. Joe Dexter	
						x					x	1. Is there a genuine need for these instructional materials?
x									x			2. Is there a market for these instructional materials?
				x		x		x	x			3. Do these instructional materials possess a clear purpose and rationale?
	x	x					x	x				4. Is the content of these instructional materials scientifically correct?
			x		x							5. Is the content of these materials educationally sound?
x							x	x		x		6. Are the proposed and anticipated outcomes of these instructional materials desirable?
					x						x	7. Do these instructional materials present implementation problems for the schools?
			x							x		8. Are the costs for implementing these instructional materials reasonable?
	x	x		x								9. Is the management/organization plan adequate for producing these instructional materials?
x	x	x	x	x	x	x	x	x	x	x	x	10. What are your general impressions of the instructional materials?

PANEL RESPONSIBILITIES

PANEL 4

Andrew Turner	Professor F[illegible]	[illegible] Sarah [illegible]	Dr John Borriello	[illegible] Ruth [illegible]	Dr. Scott Gualfano	Dr. Donald Bern	Dr. Gordon Marshucner	Dr. Les Trowbridge	[illegible] Judith Yero	Dr. Martin T. Mason	[illegible] David Pratt	[illegible] Blankenship	
x		x									x		1. Is there a genuine need for these instructional materials?
								x			x	x	2. Is there a market for these instructional materials?
x			x				x			x			3. Do these instructional materials possess a clear purpose and rationale?
	x					x	x						4. Is the content of these instructional materials scientifically correct?
		x			x				x				5. Is the content of these materials educationally sound?
	x		x	x									6. Are the proposed and anticipated outcomes of these instructional materials desirable?
					x				x				7. Do these instructional materials present implementation problems for the schools?
								x		x			8. Are the costs for implementing these instructional materials reasonable?
				x		x						x	9. Is the management/organization plan adequate for producing these instructional materials?
x	x	x	x	x	x	x	x	x	x	x	x	x	10. What are your general impressions of the instructional materials?

PANEL RESPONSIBILITIES

PANEL 5

Question	Andrew Miller	Dr. Richard Dodge	Dr. Robert E. Yager	Dr. James Stevenson	Dr. Daniel I. Burron	Dr. J. Howard Stratton	Dr. Gerald Myers	Dr. Roger Hansen	Dr. Dean Zollman	Sister Shirley Corbliss	Mr. Wayne Carlson	Mr. Fred Johnson
1. Is there a genuine need for these instructional materials?	x		x									x
2. Is there a market for these instructional materials?									x			x
3. Do these instructional materials possess a clear purpose and rationale?	x			x				x			x	
4. Is the content of these instructional materials scientifically correct?		x					x	x				
5. Is the content of these materials educationally sound?			x			x				x		
6. Are the proposed and anticipated outcomes of these instructional materials desirable?		x		x	x							
7. Do these instructional materials present implementation problems for the schools?						x				x		
8. Are the costs for implementing these instructional materials reasonable?									x		x	
9. Is the management/organization plan adequate for producing these instructional materials?					x		x					
10. What are your general impressions of the instructional materials?	x	x	x	x	x	x	x	x	x	x	x	x

PANEL RESPONSIBILITIES

PANEL 6

Question	Kevin McMahon	Dr. Ted F. Andrews	Dr. Roger K. Wangen	Dr. Hilliard Jason	Ms. Mary C. O'Brien	Dr. Marie Parnell	Dr. Robert M. Herman	Mr. Howard Stein	Dean Elwood Ehrle	Mr. Albert L. Powers	Mr. William Galbraith	Dr Elaine Ledbetter
1. Is there a genuine need for these instructional materials?	x		x									x
2. Is there a market for these instructional materials?									x			x
3. Do these instructional materials possess a clear purpose and rationale?	x	x		x							x	
4. Is the content of these instructional materials scientifically correct?		x					x	x				
5. Is the content of these materials educationally sound?			x			x				x		
6. Are the proposed and anticipated outcomes of these instructional materials desirable?				x	x		x					
7. Do these instructional materials present implementation problems for the schools?						x				x		
8. Are the costs for implementing these instructional materials reasonable?									x		x	
9. Is the management/organization plan adequate for producing these instructional materials?					x			x				
10. What are your general impressions of the instructional materials?	x	x	x	x	x	x	x	x	x	x	x	x

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

nsf

OFFICE OF THE
ASSISTANT DIRECTOR
FOR SCIENCE EDUCATION

MEMORANDUM November 26, 1975

TO : Pre-College Curriculum Review Panelists

FROM: Acting Assistant Director for Science Education

We are very pleased that you will be able to serve as a panelist for the National Science Foundation's pre-college curriculum review and evaluation. This memorandum is designed to serve three purposes. First, it provides you with information about the travel, housing and working arrangements for the panel meetings. Second, it serves as an introduction to the enclosed materials that, hopefully, you will find useful in your role as a panelist; and third, it describes your duties as a panelist in these reviews.

All panelists will convene in Room 651 at the Science Education Directorate, 5225 Wisconsin Avenue, N.W., Washington, D.C. at 9:00 A.M. Monday, December 8, 1975, at which time they will receive a general briefing and charge. They will adjourn at 3:00 P.M. on Friday, December 12. Unless you have notified us to the contrary, we will make reservations for you at the ~~Holiday~~ Inn, 5520 Wisconsin Avenue, Chevy Chase, Maryland (just a short walk from the Science Education offices). The hotel rate is $21 for a single and $29 for a double plus tax. These reservations will be from Sunday night (7th) until Thursday night (11th). If you are coming to Washington by air and have requested an open ticket from the Foundation, the open ticket should arrive under separate cover from our travel office. You will have to make your own travel reservations. Since the meeting starts on Monday morning it would be best to arrive in Washington by Sunday evening.

The Foundation will provide you with a $75 per day honorarium, per diem covering the hotel plus $14 a day for meals, not to exceed a total of $37, as well as your travel expenses. Expenses must be itemized and receipts are required for hotel and transportation. A Foundation representative will be on hand to assist you in completing your voucher. Since

the amount of work to be accomplished in Washington is great and the time is short, the Foundation is also prepared to provide $150 for two days of study time prior to your arrival in Washington. In this way, we hope that all panel members will come to Washington fully prepared to deal with the substantive issues.

The enclosed materials deserve a brief explanation; they should provide background information about the curriculum development projects which your panel will be reviewing. We are asking that each panel use the ten-questions shown in Enclosure 1 in reviewing their assigned curriculum projects. In order to aid you in answering these questions we have assembled and enclosed "evidence packages" for each of the projects that you will be reviewing. Each package contains, where applicable, three items:

1. A summary of the project, as originally designed and funded, prepared by NSF members.

2. The Principal Investigator's response to the set of questions in Enclosure 1.

3. Two or three representative instructional materials from the project.

Complete sets of instructional materials will be available in Washington for your review. During this same time you will be able to talk with project staff via phone or in person.

Panels were selected to be representative of a broad spectrum of private and professional interests and responsibilities. We want each panel member to give thought to all ten questions on each of their assigned projects. However, recognizing the difficulty of preparing panel reports in a very short time, we are asking that individual panel members assume responsibility for two questions. With other panelists assigned to the same questions, we would like you to prepare a response that reflects group judgments, both agreements and disagreements.

The chart on the attachment to this letter reflects the tentative assignments that we have made. On the chart you can see the panel membership as well as the groups that recommended each panelist for service. In addition, you can note the specific curricula that we are asking you to review as well as identify your NSF panel facilitator. This chart also contains the questions you have been specifically assigned. We have made attempts to form pairs or triads of panelists with specific assignment to questions. This strategy means that you and one or two other panelists will be asked to prepare written documentation of the panel's findings on those questions. The staff and I will address the entire group of panelists on Monday morning.

Should you have any questions or difficulties arise before then please contact your panel facilitator. Feel free to call collect to the NSF offices. We are looking forward to a productive meeting and again thank you for your willingness to participate.

Harvey Averch

Harvey Averch

Enclosures

P.S. Please bring enclosures to the meeting.

Exhibit B-11 (cont.)

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C.

OFFICE OF THE
ASSISTANT DIRECTOR FOR
EDUCATION

MEMORANDUM

December 1, 1975

TO : Pre-College Curriculum Review Panelists - Publishers' Representatives

FROM: Acting Assistant Director for Science Education

We are very pleased that you will be able to serve as a panelist for the National Science Foundation's pre-college curriculum review and evaluation. This memorandum is designed to serve three purposes. First, it provides you with information about the travel, housing and working arrangements for the panel meetings. Second, it serves as an introduction to the enclosed materials that, hopefully, you will find useful in your role as a panelist; and third, it describes your duties as a panelist in these reviews.

All panelists will convene in Room 651 at the Science Educa Directorate, 5225 Wisconsin Avenue, N.W., Washington, D. C. at 9:00 A.M day, December 8, 1975, at which time they will receive a general briefing and charge. Due to the special nature of the panel of publishers' representatives, we expect you can complete your work by 5:00 P.M., Tuesday, December 9. Unless you have notified us to the contrary, we will make reservations for you at the Holiday Inn, 5520 Wisconsin Avenue, Chevy Chase, Maryland (just a short walk from the Science Education offices). The hotel rate is $21 for a single and $29 for a double plus tax. These reservations will be from Sunday night (7th) until Thursday night (11th). If you are coming to Washington by air and have requested an open ticket from the Foundation, the open ticket should arrive under separate cover from our travel office. You will have to make your own travel reservations. Since the meeting starts on Monday morning it would be best to arrive in Washington by Sunday evening.

The Foundation will provide you with a $75 per day honorarium, per diem covering the hotel plus $14 a day for meals, not to exceed a total of $37, as well as your travel expenses. Expenses must be itemized and receipts are required for hotel and transportation. A Foundation representative will be on hand to assist you in completing your voucher. Since the amount of work to be accomplished in Washington is great and the time is short, the Foundation is also prepared to provide $75 for one day of study time prior to your arrival in Washington. In this way, we hope that all panel members will come to Washington fully prepared to deal with the substantive issues.

The enclosed materials deserve a brief explanation; they should provide background information about the curriculum development projects which your panel

will be reviewing. We are asking that each panel use the ten questions shown in Enclosure 1 in reviewing their assigned curriculum projects. In order to aid you in answering these questions we have assembled and enclosed "evidence packages" for each of the projects that you will be reviewing. Each package contains, where applicable, two items:

1. A summary of the project, as originally designed and funded, prepared by NSF members.

2. The Principal Investigator's response to the set of questions in Enclosure 1.

Complete sets of instructional materials will be available in Washington for your review. During this same time you will be able to talk with project staff via phone or in person.

Panels were selected to be representative of a broad spectrum of private and professional interests and responsibilities. We want each panel member to give thought to all ten questions on each of their assigned projects. However, we are asking that members of your panel focus on questions 1, 2, 7, and 8 for each of the two projects assigned to the panel. With the other members of the panel we would like a written response that reflects group judgments, both agreements and disagreements.

The chart on the attachment to this letter reflects the tentative assignments that we have made. On the chart you can see the panel membership as well as the groups that recommended each panelist for service. In addition, you can note the specific curricula that we are asking you to review as well as identify your NSF panel facilitator. This chart also contains the questions you have been specifically assigned. We have made attempts to form pairs or triads of panelists with specific assignment to questions. This strategy means that you and one or two other panelists will be asked to prepare written documentation of the panel's findings on these questions. The staff and I will address the entire group of panelists on Monday morning.

Should you have any questions or difficulties arise before then please contact your panel facilitator. Feel free to call collect to the NSF offices. We are looking forward to a productive meeting and again thank you for your willingness to participate.

Harvey Averch

Enclosures

P.S. Please bring enclosures to the meeting.

Exhibit B-11 (cont.)

PANEL 7

Interdisciplinary Science Instructional System

Technology-People-Environment

All Panelists Recommended by Association of American Publishers

Mr. William Moore
Executive Editor, Science School Department
670 West End Avenue, Apt. 8F
New York, New York 10025

Mr. Carl Gulfish
Executive Editor, Science
Silver Burdett
250 James Street
Morristown, New Jersey 07960

Mrs. Norma Markson
Executive Editor
Urbana Programs Department
Houghton-Mifflin
1 Beacon Street
Boston, Massachusetts 02107

Mr. Jack DeWaard
Executive Editor, Science Division
201 Creekside Drive
Palo Alto, California 94306

QUESTIONS 1, 2, 7, 8

PANEL FACILITATOR

Alphonse Buccino
Office of Program Integration
National Science Foundation
(202) 282-7947

FEDERAL REGISTER, VOL. 40, NO. 226—FRIDAY, NOVEMBER 21, 1975

51307

AD HOC ADVISORY PANEL ON CURRICULUM DEVELOPMENT

Notice of Determination

The National Science Foundation is establishing the Ad Hoc Advisory Panel on Curriculum Development in accordance with the Federal Advisory Committee Act (Pub L 92-463) and the Office of Management and Budget Circular No A-63, Revised. It is determined that the Ad Hoc Advisory Panel on Curriculum Development is in the public interest in connection with the performance of duties imposed upon the National Science Foundation (NSF) by the National Science Foundation Act of 1950 as amended and other applicable laws. This determination follows consultation with the Office of Management and Budget.

1 *Name of Panel* Ad Hoc Advisory Panel on Curriculum Development.

2 *Purpose* To examine and reassess priorities of science education by evaluating pre-college curriculum development projects on the basis of scientific merit, educational value, and effectiveness of management and financial procedures. The results of the evaluation are to be presented to Congress in February 1976.

3 *Effective Date of Establishment and Duration* The panel's establishment is effective after the charter is filed with the Director, NSF and the [illegible] committees of Congress having legislative jurisdiction of the National Science Foundation. The panel will continue for a period not to exceed four months.

4 *Membership* The Ad Hoc Advisory Panel on Curriculum Development will be composed of approximately [illegible] individuals selected from the scientific and academic communities, publishers, teachers, child development experts, [illegible] and from informed representatives of the public. There will be no discrimination on the basis of [illegible] national origin, religion or [illegible]

5 *Panel Operation* The panel will operate in accordance with provisions of the Federal Advisory Committee Act [illegible] OMB Circular No A-63, Revised [illegible] [illegible] in implementation of the Act and Foundation policies [illegible] [illegible] will be used in carrying out the panel's activities.

H GUYFORD STEVER
Director

NOVEMBER 19, 1975

[FR Doc 75 [illegible] Filed 11-20-75 8 45 am]

AD HOC ADVISORY PANEL ON CURRICULUM DEVELOPMENT

Meeting

In accordance with the Federal Advisory Committee Act P.L. 92-463, the National Science Foundation announces the following meeting:

Name Ad Hoc Advisory Panel on Curriculum Development Date December 8 through 12, 1975 Time 9 a.m. [illegible] Place Rm 6[illegible], [illegible] Wisconsin Avenue [illegible] Washington, D.C. The panel will be divided into six subpanels. Room numbers for the

51308

[illegible] meetings will be announced during [illegible] Type of meeting Open [illegible] Contact Person Mrs Frances Watts [illegible] Science Education Directorate Rm [illegible] W, National Science Foundation Washington, DC 20550, telephone (202) [illegible]

Purpose of advisory panel To examine and reassess priorities of science education [illegible] pre-college curriculum development projects on the basis of scientific merit, educational value and effectiveness of management and financial procedures. The results of the evaluations are to be presented to Congress in February 1976.

Agenda During the opening session (9 00 am to [illegible] 30 a.m.) topics will include Discussion of goals and objectives of the review [illegible] of issues and questions for each project.

The remainder of the 5-day meeting will consist of working sessions of the subpanels to review and evaluate 19 pre-college curriculum development projects.

GAIL A. MCHENRY,
Acting Committee
Management Officer.

NOVEMBER 19, 1975

[FR Doc 75-31612 Filed 11-20-75 8 45 am]

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Exhibit B-12

NATIONAL SCIENCE FOUNDATION

WASHINGTON D C 20550

nsf

OFFICE OF THE
ASSISTANT DIRECTOR
FOR SCIENCE EDUCATION

December 8, 1975

MEMORANDUM

To: Pre-College Curriculum Review Panelists

From: Acting Assistant Director for Science Education Harvey Averch

Subject: Release of Information

We are planning to make the following data available to you if you need them:

1. The complete original proposal submitted by the grant applicant to NSF, plus addenda that may have been submitted in the award process.

2. Awarded proposals and addenda to fund dissemination and training activities with respect to developed curricula.

3. Curriculum conference reports.

4. Developer's and NSF progress reports.

5. Existing NSF formative and summative evaluations.

6. Third party formative and summative evaluations.

7. Memoranda and correspondence between NSF program officers and project directors.

8. Project progress reports.

I am satisfied that the eight items above can be released for this evaluation without injury to any important interests. As already discussed we cannot make available the verbatim peer reviews. These were acquired under conditions of confidentiality to the extent permitted by law. Substantive summaries of the reviews have already been made available.

Panelists themselves are here because they are aware of alternative curricula to those developed by NSF. We hope you will bring your expertise to bear on the issues of needs and markets, since these are questions we have specifically requested that you address.

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Exhibit B-13